ACG+
User Manual

The ACG+ must be returned to Analox in its original storage and transit case.

Failure to do so may result in damage which will be chargeable.

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1 Contents checklist

1.1 Standard contents

1.1.1 Below is a list of standard contents which will be supplied to the customer

a) ACG+ unit (Including transport case)
b) USB lead
c) 0.1l/m restrictor kit (For sampling using Oilmist colourmetric tubes)
d) A printed copy of the user manual (A4 booklet)
e) Software CD
f) Test certificate

1.2 Optional accessories

1.2.1 Below is a partial list of optional accessories which could be supplied to the customer depending on the order. The full spares & accessories list can be found on page 57.

a) Li-Ion rechargeable battery pack kit (Includes battery mounting case & charger)
b) NiMH rechargeable battery pack kit (Includes battery mounting case & charger)
c) External PSU (If not using rechargeable battery pack option, connection via front panel)
d) External PSU (For fixed installation using cable gland direct to interface PCB)
e) External beacon (For fixed units only)
f) Pressure regulator (2 stage)
g) Humidifier (For when the ACG+ is in constant use)
h) Mounting kit to install on either a solid wall or instrument panel (For fixed units only)
i) Gland and Override Keyswitch kit (For fixed units only)

The humidifier (g) should be installed if the ACG+ is going to be continuously connected for over 12 hours to the compressed gas source with no exposure to ambient air. The humidifier is required to pull moisture from the ambient air to re-hydrate the electrochemical cells within the ACG+. If dry gas is constantly being passed over the sensors they will dry out and stop performing correctly.

2 Safety information

WARNING: Read the safety information fully before using the **Analox ACG+**.

2.1 Electrochemical sensors (oxygen and carbon monoxide)

Electrochemical sensors contain toxic compounds. Under normal conditions the sensor will be safely sealed. To prevent leakage, the unit must not be exposed to temperatures outside the specified range, or be exposed to organic vapours, which may cause physical damage to the body of the sensor. The unit must not be stored in areas containing organic solvents or in flammable liquid stores.

When the life of the sensor has expired or it is leaking or otherwise damaged it must be disposed of safely in accordance with local regulations.

The carbon monoxide cell contains an acidic electrolyte (sulphuric acid) whilst the oxygen cell contains caustic electrolyte (potassium hydroxide). In the event of an accident, use the following first aid procedures.

Table 1 Electrochemical sensor first aid procedures

Body Part	Effect	First Aid Procedures
Skin	Contact could result in a chemical burn. Persons with pre-existing skin disorders may be more susceptible to the effects of the substance.	Immediately flush the skin thoroughly with water for at least 15 minutes. Remove contaminated clothing and wash before re-use. Obtain medical advice if continued irritation.
Ingestion	Corrosive. May cause sore throat, abdominal pain, nausea, and severe burns of the mouth, throat, and stomach, and may be fatal.	If swallowed DO NOT INDUCE VOMITING. Wash out mouth thoroughly with water and give plenty of water to drink. Obtain medical advice immediately
Eye	Persons with pre-existing eye problems may be more susceptible to the effects of the substance. Corrosive. May cause redness, pain, blurred vision, and eye burns. Contact can result in the permanent loss of sight.	Irrigate thoroughly with water for at least 15 minutes. Obtain medical advice immediately.
Inhalation	Persons with pre-existing impaired respiratory function may be more susceptible to the effects of the substance. Inhalation is not an expected hazard unless heated to high temperatures. Mist or vapour inhalation can cause irritation to the nose, throat, and upper respiratory tract.	Remove to fresh air. Rest and keep warm. Obtain medical advice if applicable.

Should leakage of any electrolyte occur as a result of misuse, incorrect operation, manufacturing error, physical damage, etc. then wear protective gloves when cleaning any spills. Should electrolyte contact skin then the affected area should be washed thoroughly with copious water and medical advice sought if there has been any contact with the eyes or mouth. If connected to any electrical equipment, the sensor should be immediately removed.

2.2 PID lamp cleaning kit

The PID lamp cleaning kit (9300-1022) contains a vial of cleaning compound which contains alumina (CAS Number 1344-28-1) as a very fine powder.

Hazard identification: May cause irritation of respiratory tract and eyes

Storage: Keep container closed to prevent water absorption and contamination

Handling:

- Do not breathe in the powder, avoid contact with skin, eyes and clothing
- Wear suitable protective clothing
- Follow industrial hygiene practices, wash face and hands thoroughly with soap and water after use and before eating, drinking, smoking or applying cosmetics
- The powder carries a TVL (TWA) limit of 10mg/m^3

2.3 Inlet pressure & flow

The system maximum inlet pressure is 10 bar gauge (145 psig). Ensure that appropriate pressure reduction measures have been taken when connecting the sample inlet. Pressure relief is fitted to the unit such that damage from over pressurisation is minimised but units may still be damaged.

3 Introduction

The ACG+ is a multi sensor gas analyser, specifically designed for the analysis of contaminants in compressed breathing air. The ACG+ can be used as a portable instrument for use between compressors on site or can be permanently connected to a compressor outlet, enabling you to continually verify the quality of your breathing air. This delivers a much greater degree of system safety than a 3 or 6 month spot check. The unit will provide continuous 'on line' monitoring of O_2, CO_2, CO, volatile organic compounds (VOC) and water vapour in compressed breathing air lines.

3.1 ACG+ overview

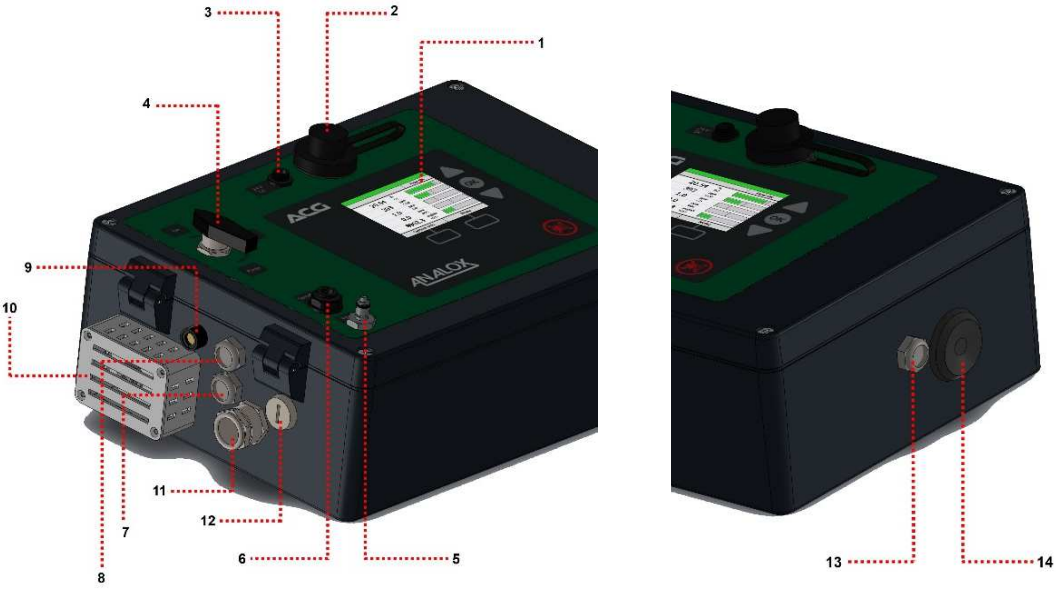


Figure 1 - ACG+ overview

1) Display
2) USB port for data-download, with waterproof cap
3) Power connection (Via either optional rechargeable battery pack or external mains adaptor)
4) Gas inlet/purge valve
5) Gas inlet/calibration port
6) Sample support port
7) Exhaust
8) Exhaust
9) Breather
10) Humidifier (Optional)
11) M16 cable gland (Optional)
12) Override keyswitch (Optional)
13) Exhaust
14) Blow out blanking plug

4 Installation details

4.1 Mechanical overview

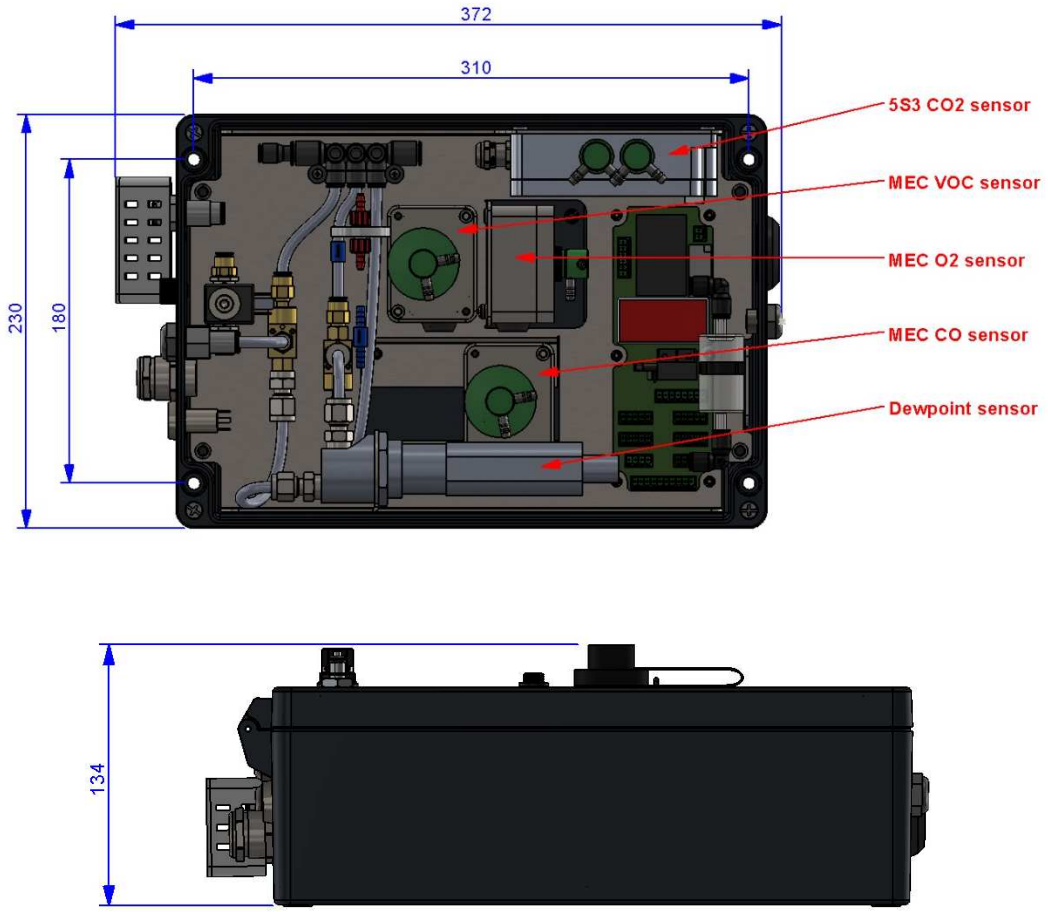
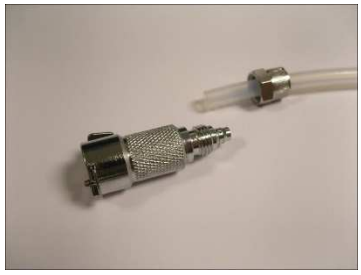


Figure 2 - ACG+ mechanical overview

4.2 Gas sample connection (Both fixed and portable versions)

- The sample gas inlet to the ACG+ must be at a regulated pressure in the range of 5 to 10 bar gauge (72.5 to 145psig), taken directly from a sample line from a compressor, after all filtering and regulation, which is supplying the bottles, air banks or breathing masks.
- The ACG+ is supplied with a 2m length of 6mmOD x 3mmID PTFE tubing which the inlet/calibration adaptor should be connected to. Longer pipes can be used but purge times and response times will be longer.
- It is recommended that a 2-stage regulator is used to maintain the sample gas inlet pressure within operating limits.
- The ACG+ provides a Linktech panel mount coupling for the connection of the sample gas line or calibration gas and also a Linktech inline socket (Which accepts up to ¼" OD tubing) for connection to the ACG+ panel mount coupling.
- Before fitting the pipe-work the PTFE tubing should be fitted to the rear of the supplied Linktech inline socket.
- The ID at one end of the PTFE tubing will require stretching slightly to fit over the rear of the Linktech inline socket.

- Remove the nut from the rear of the Linktech inline socket and place over the supplied length of PTFE tubing.



- Fit the 6mmOD x 3mmID tubing over the end of the Linktech inline socket by slightly stretching the inner of the tube so that it fits over the rear of the adaptor and secure in place with the nut.

- At the free end of the PTFE tubing, a compression nut should be fitted to connect to the regulated pressure source.

4.3 Installation (Portable)

The ACG+ Portable can be powered by either the optional rechargeable battery pack (Li-Ion or NiMH variants) or an external PSU. Both options connect to the front panel power connector located next to the USB port.

Gas connection should be made as per section 4.2

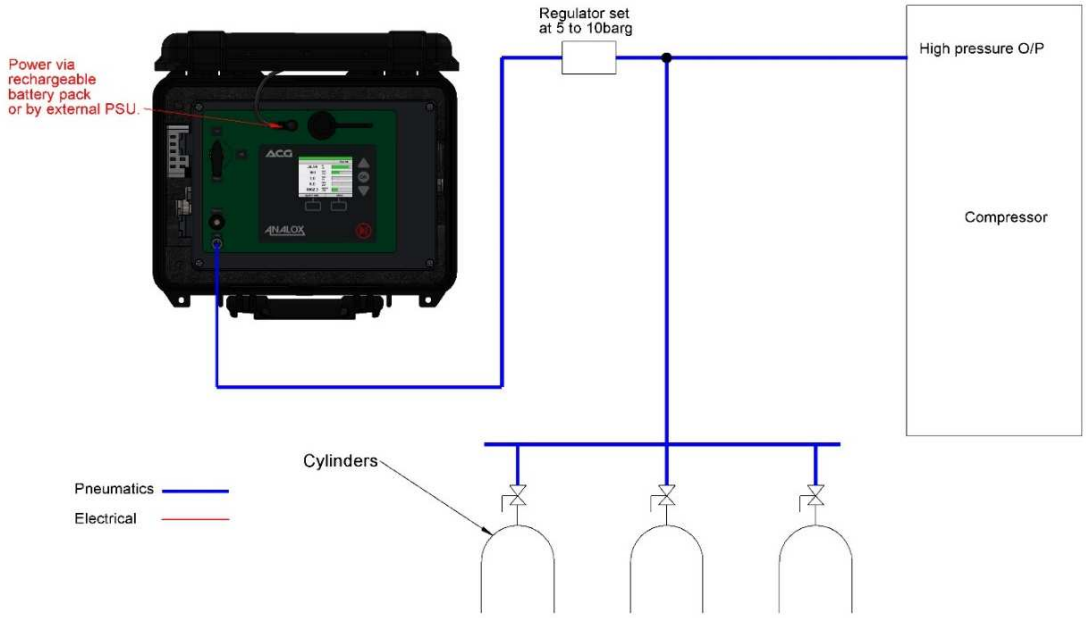


Figure 3 Typical ACG+ Portable installation

4.3.1 ACG+ power (Portable or fixed)

Power should be applied using either the optional rechargeable battery pack or the optional external PSU. Connection should be made through the 3 way panel mount socket on the front panel located next to the USB connector.

4.3.2 Charging the optional rechargeable battery pack

To charge the optional rechargeable battery pack the charger supplied with the battery pack kit **MUST** be used as these are set to supply the correct power to the battery during charge.

Note: Using any other charger will invalidate your warranty.

- Connect the charger connector to the battery connection lead coming from the battery case (This will only fit one way) and secure using the bayonet nut on the battery cable.
- Plug the charger into a mains supply, the charger will do a battery check prior to charging (For a NiMH charger the LED will be yellow)
- If any faults are found the NiMH charger LED will flash orange/green, the Li-Ion chargers red LED will extinguish.
- If all is okay the charger will then start to charge the battery (For NiMH chargers the LED will be orange and for Li-Ion chargers the LED will be red).
- Once the charge is complete, the charger will go into trickle mode until disconnected (For a NiMH charger the LED will go green, for Li-Ion chargers the red LED will extinguish).
- Once complete, disconnect the charger, the battery is then ready for connection to the ACG+.

4.4 Installation (Fixed)

4.4.1 Mounting details (ACG+ Fixed)

The ACG+ can be mounted as a fixed unit onto a wall or vertical flat surface using the enclosure mounting holes. The minimum area required and the mounting centres for installing the ACG+ are shown in Figure 2.

Gas connection should be made as per section 4.2

Below shows a diagram of a typical fixed system setup.

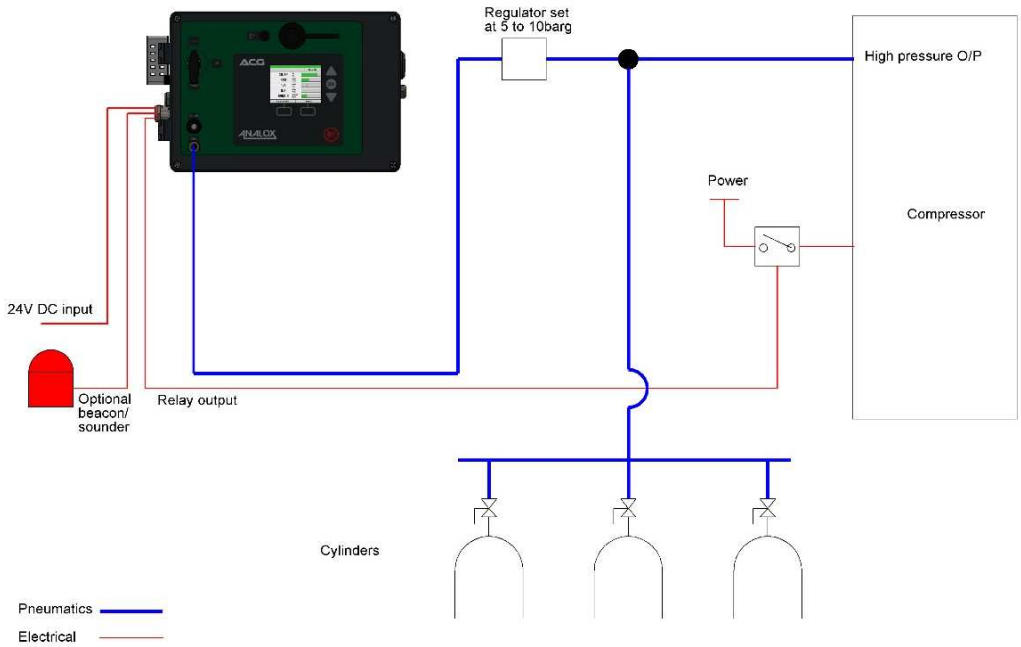


Figure 4 Typical ACG+ Fixed installation

An optional mounting kit to install on either a solid wall or instrument panel can be purchased.

ACG+ mounting kit contents:

- 4 x Socket head cap screw, M6x60mm.
- 4 x M6 full nut, A4 SS.
- 4 x M6 washer, A4 SS.
- 4 x Multi wall fixing, M5 x 50mm (rubber insert and M5x50mm slotted screw).

4.4.2 Solid wall mounting (ACG+ Fixed)

- Mark on the wall the mounting hole drill positions and drill 10mm holes.
- Remove the M5x50mm screw from the rubber insert and fit the rubber inserts into the drilled holes.
- Open the ACG+ lid and offer up the unit to the mounting surface.
- Place an M5x50mm slotted screw in each of the 4 enclosure mounting positions and screw in to the previously fitted rubber inserts.

4.4.3 Panel mounting (ACG+ Fixed)

- Mark on the panel the mounting hole drill positions and drill 6.5mm holes.
- Open the ACG+ lid and offer up the unit to the mounting surface.
- Place a socket head cap screw in each of the 4 enclosure mounting positions and through the drilled holes in the mounting panel.
- Fit an M6 washer over each of the screw thread at the back of the mounting panel.

- Fit an M6 full nut to the screw thread at the back of the mounting panel and fully tighten (alternatively, the screws could be fitted into M6 tapped holes with the M6 nuts not required).

4.4.4 Electrical connection

The user terminals are located at J3 and J17 on the chassis PCB of the ACG+ as shown in Figure 5.

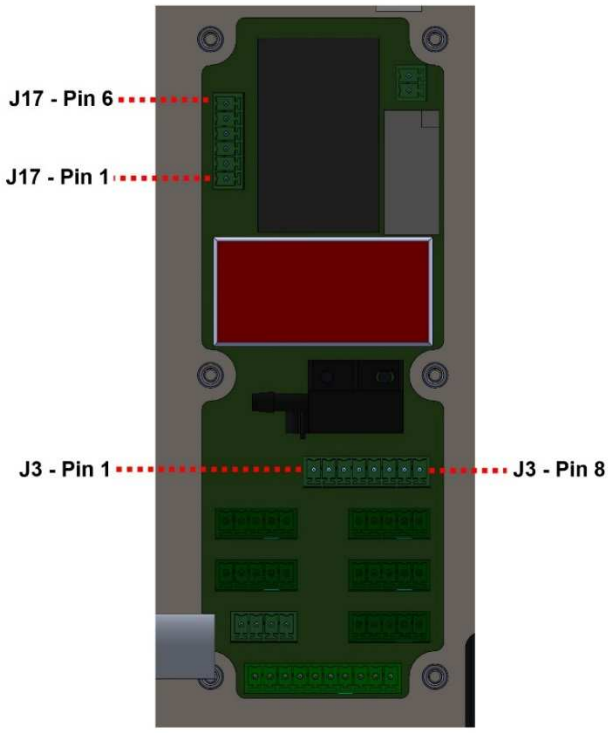


Figure 5 - Connector locations

Table 2 Connector J17 pin assignments

Connector J17 pin assignments		
Terminal No.	**Function**	**Details**
1	ACG+ power (+ve)	9 to 36V DC, 24W max
2	ACG+ power (-ve)	
3	Interlock relay contacts – normally-open (1)	Volt-free relay contacts. 8A @ 24V max. Relay contacts are normally open in power off conditions. This pair of contacts will be closed circuit under nominal conditions and open circuit in fault or alarm conditions (see section 4.5).
4	Interlock relay contacts – normally-open (2)	
5	Interlock relay contacts – normally-closed (1)	Volt-free relay contacts. 8A @ 24V max. Relay contacts are normally closed in power off conditions. This pair of contacts will be open circuit under nominal conditions and closed circuit in fault or alarm conditions (see section 4.5).
6	Interlock relay contacts – normally-closed (2)	

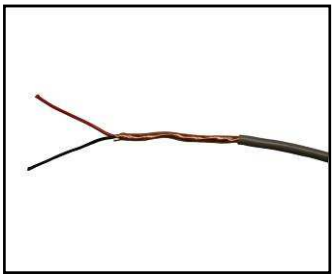
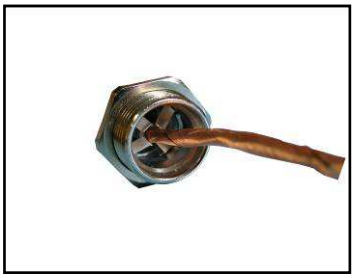
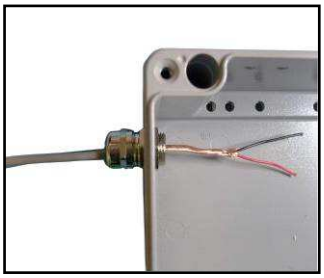
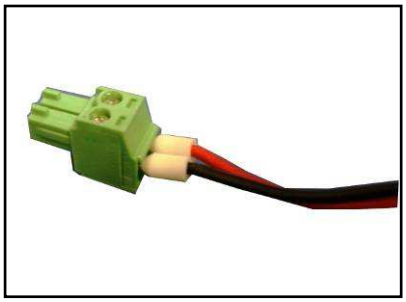
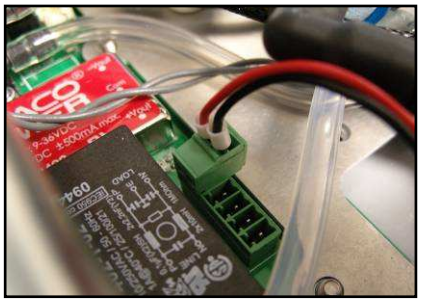
Table 3 Connector J3 pin assignments

Connector J3 pin assignments		
Terminal No.	**Function**	**Details**
1	Solenoid drive (+ve)	Not for user connection
2	Solenoid drive (-ve)	
3	Reserved	Not for user connection
4	Reserved	
5	+24Vdc	Max total load of 500mA is available between the 3 switched outputs
6	Output 1 – switched to 0V	
7	Output 2 – switched to 0V	
8	Output 3 – switched to 0V	

Note: Max cross-sectional area for the terminals is 1.5mm^2

4.4.5 ACG+ power (Fixed)

The ACG+ requires a power supply of 15 to 36V DC and will consume 20 Watts maximum. It is recommended that power should be supplied using a screened, twisted pair cable, with the cable screen clamped by the EMC cable gland, this should then be terminated to J17 pins 1 & 2 as shown.

4.5 Safety interlock relay (ACG+ Fixed)

The ACG+ has a double pole change-over relay that can be used to control external equipment in the event of an alarm or fault condition.

Two sets of volt-free relay contacts are provided; a normally-open pair which are held closed under ideal conditions, failing safe to their open state when a non-ideal state is identified and a normally-closed pair which are held open under ideal conditions. Figure 6 shows the operational state of the relay under various system conditions.

A typical use of the interlock relay might be to use the normally-open pair to cut power to a compressor or to close a filling valve on an alarm, fault condition, or in the case of power loss. Alternatively, the normally-closed pair can be used to activate external, self-powered alarm equipment such as a beacon. Table 4 shows a typical example of the relay used in a system

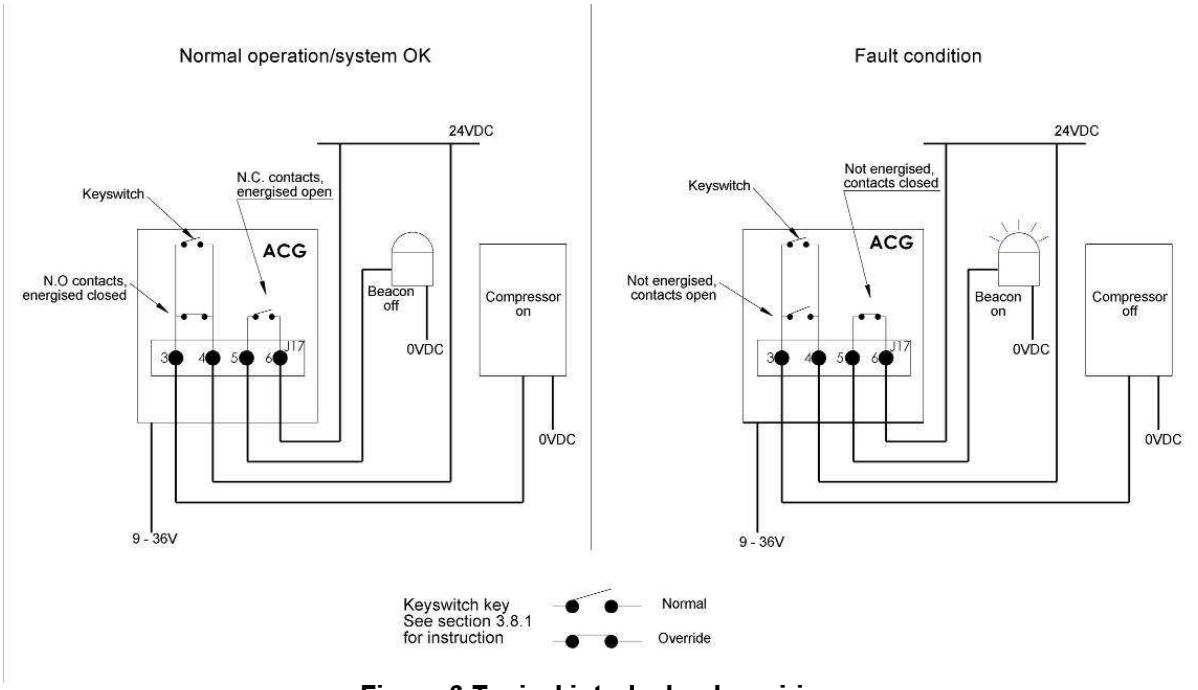


Figure 6 Typical interlock relay wiring

4.6 Safety interlock override key-switch (ACG+ Fixed)

If an ACG+'s safety interlock relay (If fitted) is attached to external equipment, there may be circumstances where it is not desirable for the ACG+ to disable the equipment attached under alarm or fault conditions. The ACG+ provides an optional override key-switch, mounted on the left side of the unit. With the key-switch set to 'Normal', the external equipment will be switched in the event of an alarm or fault conditions. If the key-switch is set to the 'Override' position then the external equipment will not be affected by alarm and fault conditions (Section 5.4.2). Table 4 shows how the key-switch affects the various system outputs.

Note: The safety interlock override key-switch only applies to equipment connected to the normally-open pair of contacts (J17, pins 3 & 4).

Table 4 Relay and 24V output operation under fault and alarm conditions

System condition	Key-switch state	Interlock relay (normally-open pair)	Interlock relay (normally-closed pair)	Switched 24V output 1	Switched 24V output 2	Switched 24V output 3
ACG+ power off	Normal	Open circuit	Closed circuit	Off	Off	Off
	Override	Closed circuit				
Ideal conditions (no alarm or fault)	Normal or override	Closed circuit	Open circuit	Off	Off	Off
Inlet alarm only (flow or inlet pressure alarm)	Normal or override	Closed circuit	Open circuit	On	On	On
Sensor alarm active	Normal	Open circuit	Closed circuit	On	On	On
	Override	Closed circuit				
System or sensor fault active	Normal	Open circuit	Closed circuit	On	On	On
	Override	Closed circuit				

4.7 Switched 24V DC outputs (ACG+ Fixed)

The ACG+ has 3 switched 24Vdc outputs that provide power to external equipment is the event of an alarm condition or system fault. These can be used to power directly equipment such as, for example, a beacon, an audible alarm, or to energise a relay. They can also be used as an input signal to an external control system. Table 4 shows how the switched 24V outputs operate under various system conditions.

Figure 7 shows a typical example of the switched 24V DC outputs used in a system.

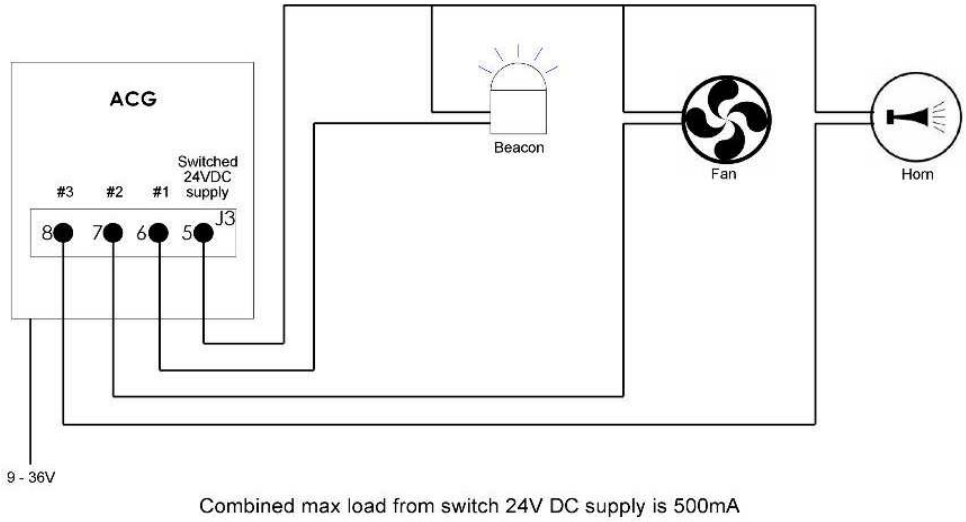


Figure 7 - Typical use of switched 24V outputs

5 Operating instructions

5.1 Start-up

An ACG+ will automatically start up when power is supplied to it. Initially, the ACG+ will display a splash screen as shown in Figure 8 which will be displayed for a few seconds after which the display will go blank for up to 15 seconds. The ACG+ will then show the main display as described in section 5.4.1

Upon start-up, attached sensors may require a short time to warm up as described in section 5.8.3

Note: If any equipment used with the ACG+ is connected into the safety interlock relay (section 4.5), then depending on the connection scheme, it may be necessary to switch the safety interlock key-switch to the override position during start-up and until the sensors have stabilised on a steady gas flow. This prevents any disruption to attached equipment during start-up due to any alarms (for example, a high alarm due to atmospheric air present in internal plumbing).

Figure 8 - Start-up splash screen

5.2 Controls

Figure 9 shows the elements of the ACG+ front panel.

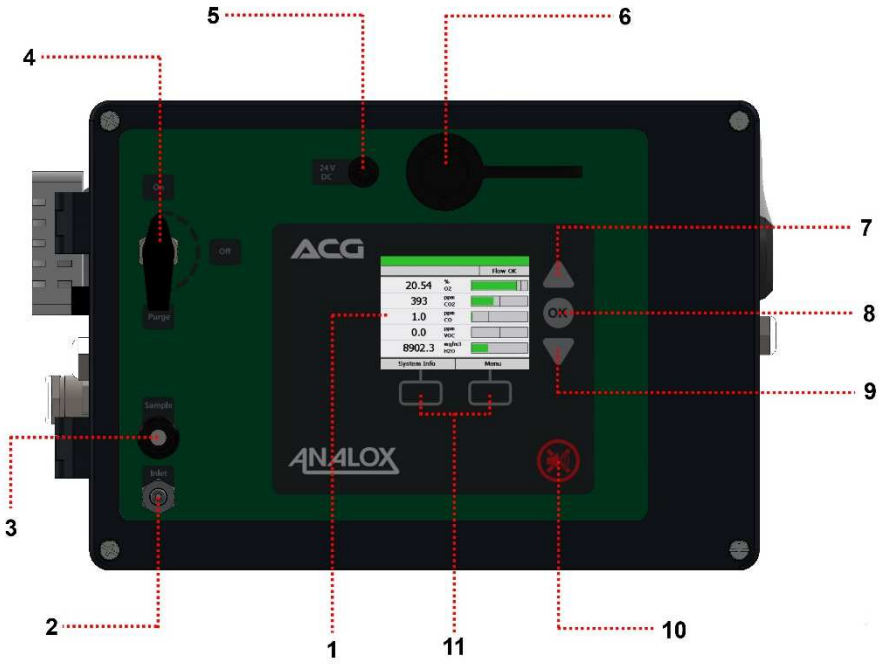


Figure 9 - ACG+ front panel

1) Display
2) Sample/Calibration gas inlet
3) Gas outlet for timed sample support (section 5.15)
4) Gas inlet/purge valve
5) External power connection (Either by rechargeable battery pack or external PSU)
6) USB port
7) Up button
8) OK button
9) Down button
10) Mute button
11) Context sensitive buttons (function depends on current context)

5.3 Inlet/purge valve

5.3.1 Use of the inlet/purge valve

The inlet/purge valve is used to control the flow of gas into the ACG+. It has two functions, firstly to turn the flow of gas through the sensors on and off, and secondly to vent the inlet, to purge any stale gas in the line.

Analox recommend that the purge system is used whenever a new pipe connection is made to the ACG+, if the inlet line has been open to atmosphere or it has been exposed to damp gas. The following instructions apply when using the supplied 2m PTFE pipe. If shorter or longer lengths of pipework are used, the purge period should be adjusted accordingly, depending on the total pipe length. Only stainless steel or PTFE/FEP pipework should be used to connect to the ACG+.

Starting with the valve in the "off" position, apply pressure to the inlet (Between 5 and 10 bar gauge) using the supplied Linktech inlet/calibration connector.

Once pressure is applied, the valve should be turned to "Purge" and left for 2 minutes (Using the supplied 2m PTFE pipe) so that the pipework prior to the ACG+ can be purged of any stale, damp gas, and any moisture on the pipe walls can be dried out.

Once the purge has completed, the valve can then be turned to the "On" position to allow the sensors to start analysing the gas sample. This process will ensure the ACG+ sensors can stabilise as quickly as possible to the gas you wish to measure.

5.4 Display

5.4.1 Main display screen

Under normal operation the ACG+ will display its main display screen. Figure 10 explains the elements of the main screen.

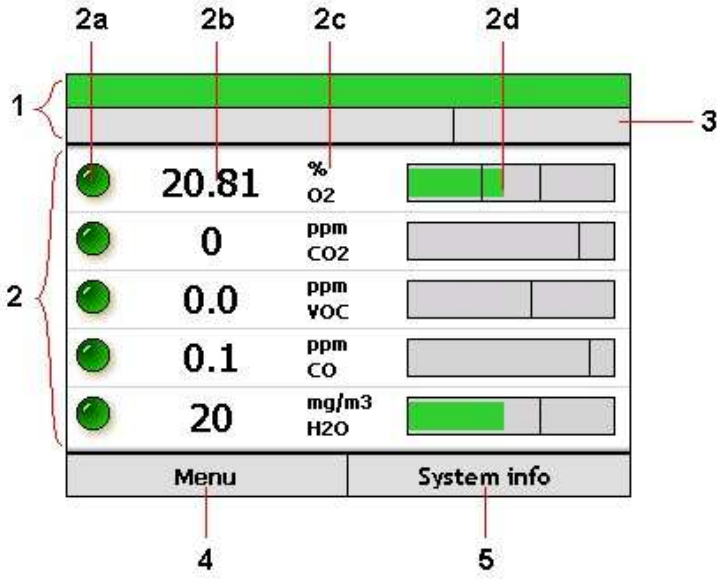


Figure 10 - Main display overview

1. System status indicator
2. Live sensor readings
    a. Sensor status icon
    b. Sensor reading
    c. Sensor type and display units
    d. Sensor bar indicator

3. System information bar
4. Left context menu button (used to access menu in the case shown)
5. Right context menu button (used to access the system information page in the case shown).

5.4.2 System status indicator

The system status indicator shows the current status of the ACG+ system. If any alarm condition has been identified then the system status indicator will turn red and display the word 'Alarm'. If any system fault is identified then the status indicator will turn yellow and display the word 'Fault'. If no current alarm or fault conditions have been identified then the system status indicator will turn green. Figure 11 shows examples of system status indicator states.

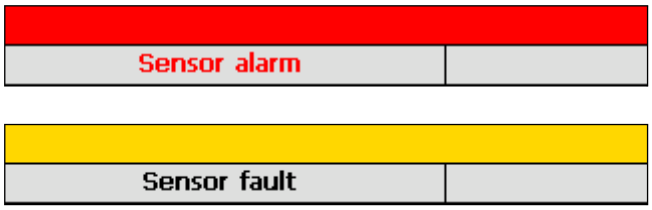


Figure 11 - System status indicator

The system indicator also shows system diagnostic information regarding system parameters of flow and input pressure. If an operational parameter is out of specification, it shall be indicated in the system parameters information box. See troubleshooting (section 7) for explanation of system fault codes.

5.5 Menu

The device main menu can be accessed from the main screen by pressing the left context button (Figure 12).

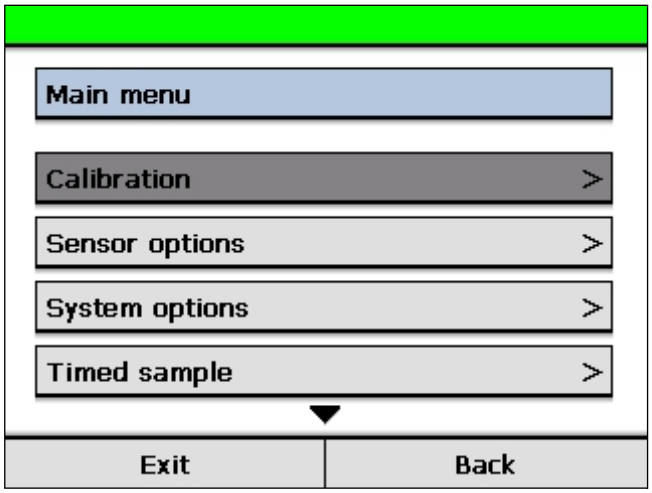


Figure 12 - The main menu

The highlighted menu option can be changed by using the up and down buttons. An arrow at the top or bottom of a menu indicates that there are more menu options above or below those currently shown.

To select a menu item, highlight it and press the 'OK' button. Depending on the menu item selected, the selected action will be performed or a sub-menu will be displayed. Figure 13 shows the backlight sub-menu.

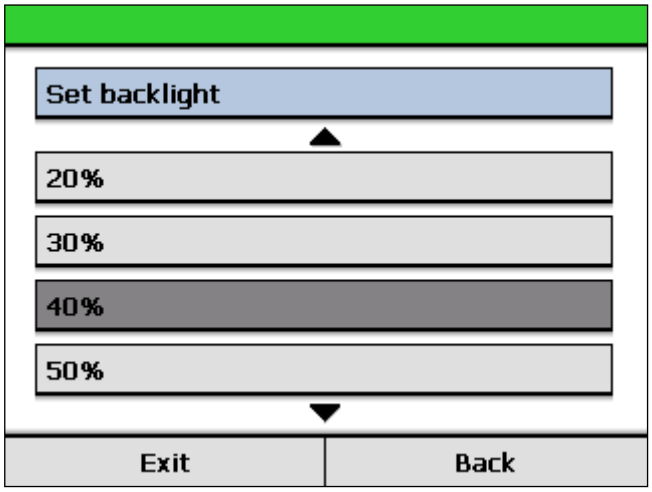


Figure 13 - The backlight sub-menu

Selecting the back option from a sub-menu will return to the previous menu level. The exit context button can be pressed at any time whilst using the menu to return to the main screen.

5.6 Adjusting the backlight

The brightness of the ACG+ display can be changed to suit the lighting conditions of its location by adjusting the backlight intensity. To adjust the backlight level, enter the main menu and select 'System options>Backlight'. Next select the desired backlight intensity level (10 to 100%) from the menu.

Note: Due to the nature of the display technology, the maximum intensity of the display will slightly degrade over the lifespan of the product. For new systems it is recommended that the backlight is set to an initial intensity level of 60% or less to maximise the lifespan of the display.

5.7 System flow

For accurate analysis of a gas sample, a reasonable flow must be maintained to the ACG+'s sensors. The internal flow is automatically regulated by the ACG+ provided that an appropriate sample inlet pressure is provided (see section 10.1 for inlet pressure ratings). The ACG+ constantly monitors its internal flow. If the parameters are outside of its nominal range, a warning alarm will be triggered and the horn will be sounded.

In addition, when an unsuitable flow rate is measured, all sensor values will be marked as uncertain (grey icon) along with a flashing indication that the flow rate is currently invalid.

The measured flow rate can be viewed on the system information screen as described in section 5.11.

Note: Alarms triggered by flow do not affect the current state of the safety interlock relay (Fixed variants) (see section 4.5).

5.8 Sensor readings

5.8.1 Sensor reading update

A live reading from each sensor will be displayed in a sensor window on the main display. This reading will be updated on the display once per second. If no valid sensor reading is currently available then three dashes ('---') will be shown instead. This may occur if the sensor has identified a fault in its operation or on occasions where the sensor reading is unavailable due to routine processing such as after a calibration adjustment has been performed.

5.8.2 Sensor status

The sensor status icon is shown to the left of each sensor reading. This icon indicates the current status of the sensor. The meaning of each sensor icon is explained in Table 5 below.

Table 5 Sensor status icons

Icon	Meaning
GREEN	**OK.** The sensor is returning a value which is within alarm limits.
RED	**Alarm.** The sensor is returning a value which is outside of an alarm set-point. This icon will flash when a new alarm condition is identified and until the alarm is acknowledged by pressing the mute button. See section 5.9 for more on alarms.
GREY	**Uncertain.** This icon is shown when the sensor is returning a reading which is within alarm limits but the reading cannot be guaranteed correct, for example, when there is low gas flow through the system. This icon will be accompanied by a status code. See troubleshooting section for further information on the specific condition.
	Fault. This icon indicates that a fault has been identified with the sensor. This icon will be accompanied by a status code. See troubleshooting section for further information on the specific condition. This icon will flash when a new fault condition is identified and until the fault is acknowledged by pressing the mute button.
	Processing. This animated icon indicates that the digital sensor module is performing some internal function. This icon will be shown when the sensor is in warm-up or has been re-connected (section 5.8.3)
	Calibration due. This flashing icon is intended as a reminder that the sensor should have a calibration adjustment performed (section 5.10.5).
	Replacement due. This flashing icon is intended as a reminder that the sensor or element of the sensor should be replaced (section 5.14).

5.8.3 Sensor warm-up

Under certain circumstances, when a digital sensor attached to the ACG+ cannot display a valid reading, the display will show that the sensor is in a warm-up state. Warm-up occurs when the ACG+ is initially powered up and may last 10 to 60 seconds depending on the sensor type attached. Under certain circumstances the sensor may enter a warm-up state whilst it processes information such as after a calibration adjustment has been attempted or when a sensor is re-connected after being disconnected. Whilst in a warm-up state, the display reading for the sensor is shown as three dashes ('---') and a warm-up processing animation is displayed (Figure 14).

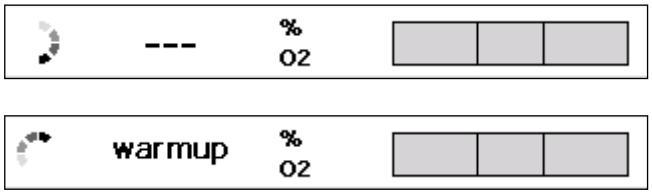


Figure 14 - Example of a sensor that is in a warm-up state

5.8.4 Sensor bar graph indicator

The sensor bar graph indicator is used to display information regarding the current sensor reading and its associated alarms. The sensor bars are automatically scaled to best show the current sensor with respect to its alarm set-points. The left hand edge of the bar is not necessarily representative of zero. For sensors such as oxygen where there is both a low-going and a high going alarm, this allows the region around the alarm set-points to be shown more clearly. The bar graph is not intended to show absolute readings.

For sensors where only a single high-going alarm set-point is defined, such as carbon dioxide, the bar will be scaled from zero to an amount above the high-going set-point. This allows any rising carbon dioxide levels to be seen with respect to the alarm set-point.

The bar will change colour depending on the current sensor status. Where a sensor is in a non-alarm and non-fault state, the bar graph will be shown green as shown in Figure 15a below. Should the sensor value be in an alarm state, the bar will be shown in red. Figure 15b and Figure 15c which show a low and high alarm respectively.

Figure 15 - Sensor bar graph indicator

In circumstances where a reading is available but is in a degraded state (e.g. a timely calibration has not been performed), the sensor bar graph indicator will be shown grey as shown in Figure 16a below. Should no reading be available, the bar graph will show no reading as shown in Figure 16b below.

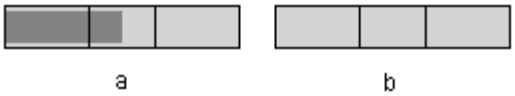


Figure 16 - Degraded state sensor bar graph indicator

In cases where the reading falls outside of the displayed range of the bar graph, the bar graph indicator will show a directional arrow to indicate the reading is outside of the displayed region as shown in Figure 17 below.

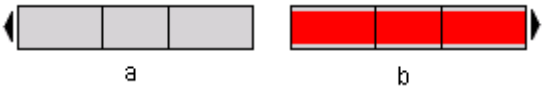


Figure 17 - Out of display range bar graph indicators

In cases where a sensor fault has been identified and a reading can still be obtained from the sensor, the bar graph will be show coloured yellow (Figure 18).

Figure 18 - Sensor in fault bar graph indicator

5.9 Alarms

Every second, as the sensor reading is updated, each alarm associated with the sensor is checked against the current reading. For high-going direction alarms, an alarm condition will be triggered if the sensor reading is greater than the alarm set-point. Conversely, for low-going direction alarms, an alarm condition will be triggered if the sensor reading is less than the alarm set-point.

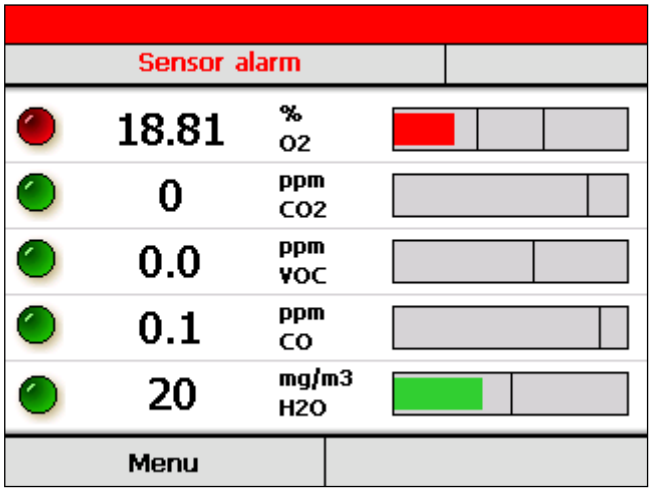


Figure 19 - A low-going alarm that has been triggered

When an alarm condition is identified the horn will immediately sound and the system status indicator will turn red, showing the word 'alarm'. In addition the sensor reading will be displayed with a flashing red status indicator and the reading bar graph will turn red, showing the reading outside of the alarm threshold. Figure 19 shows an example of a low-going alarm that has been triggered by a low oxygen reading.

5.9.1 Muting alarms

When an alarm condition is triggered and the horn sounds, the horn can be muted by pressing the mute button. This will mute the horn on all occasions where the horn is activated. In addition, when an alarm is muted, the sensor status indicator on the display will stop flashing and will instead be shown in solid red to indicate that the alarm has been acknowledged.

Figure 20 - Mute Button

5.9.2 Clearing alarms and hysteresis

To avoid nuisance re-triggering of alarms when a sensor reading is fluctuating around an alarm set-point, each alarm has a hysteresis band applied to it. This hysteresis applies to the clearing of an already triggered alarm. An alarm will always trigger immediately when the sensor reading passes the set-point in the correct direction. However, when the sensor returns in the opposite direction through the same set-point, it must go an amount beyond the set-point before the alarm will clear. This extra amount required to clear an alarm is the alarm's hysteresis. Figure 21 shows an example of a hysteresis band on a high going alarm.

The hysteresis applied to an alarm is adjusted automatically based on the value of the alarm set-point. Hysteresis for each sensor range is defined by a percentage of set-point and a maximum hysteresis value. The hysteresis applied to the alarm is the smaller of the two values for a particular set-point. Table 6 shows the hysteresis applied to each sensor type.

Table 6 Scaled hysteresis values

Sensor	Percent of set-point hysteresis	Maximum hysteresis
% O_2	5%	0.5% O_2
ppm CO_2	5%	50ppm CO_2
ppm CO	5%	0.5ppm CO
ppm VOC	5%	0.5ppm VOC
mg/m^3 H_20	5%	5mg/m^3 H_20

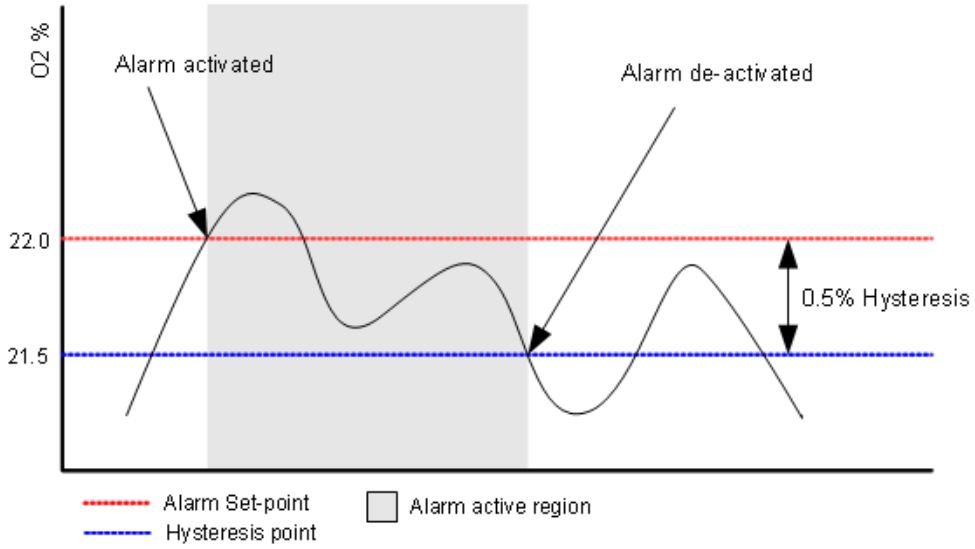


Figure 21 - Hysteresis band on a high going oxygen alarm

5.9.3 Latching alarms

Alarms can operate in either latching or non-latching mode.

With latching alarms **disabled**, if an alarm is triggered and the sensor reading subsequently returns to a level that would not trigger the alarm, the visual and audio indicators will be cancelled as soon as the reading passes the hysteresis point (see section 5.4.2)

With latching alarms **enabled**, if an alarm is triggered and the sensor reading subsequently returns to a level that would not trigger the alarm, the visual and audio indicators will continue until the mute button is pressed to acknowledge the alarm. Once acknowledged, the visual and audio indicators will be cancelled. Whilst latching is **enabled**, if an alarm is acknowledged by pressing the mute button prior to the sensor reading passing back through the alarm set-point then the visual and audio indicators will be cancelled as soon as the reading passes the hysteresis point (see section 5.4.2).

The alarm latching option can be turned on and off through the device menu. This can be found in the main menu under 'System options>Alarm latching'. The latching alarm option can also be changed using the PC tool (see section 6.3).

5.9.4 Adjusting alarm set-points

Each of the ACG+'s alarm set-points can be individually adjusted to suit the monitoring application. To adjust a set-point, first select the alarm using the 'Sensor options' sub-menu from the main menu (Figure 22). Select the sensor of interest and select 'Adjust alarms'. A list of the available alarms will be shown in the next menu. Select which alarm to adjust and the alarm adjustment screen will be shown.

Figure 22 - Selecting a CO_2 alarm to adjust

Using the up and down adjustment keys, adjust the alarm set-point to the required value (Figure 23). Once the desired new set-point is shown, press 'Accept' to store the new value. Press 'Cancel' to leave the alarm set-point unchanged.

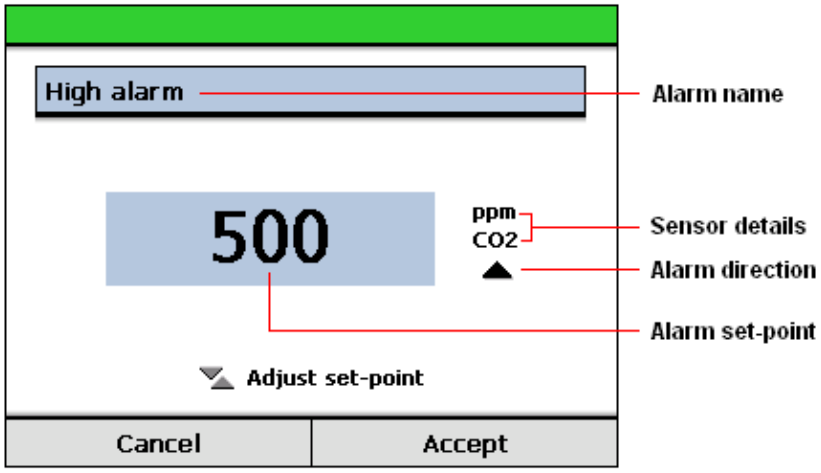


Figure 23 - Example of alarm set-point adjustment

5.10 Calibration adjustment

Whilst in use, an ACG+'s sensors should be periodically calibrated at intervals deemed necessary for the monitoring application, by exposing the sensor to gas of a known concentration. Due to effects such as depletion of electro-chemical cells over time, sensor readings shown when they are exposed to a gas of known concentration may differ from the expected value. To compensate for these effects, calibration adjustments of the sensors can be made where necessary as follows.

Each sensor's output is defined by two calibration points, one low and one high. To perform a successful calibration adjustment, both low and high calibration points should be adjusted.

Note: The high and low calibrations performed on a sensor should be selected appropriately. Some sensors (e.g. carbon dioxide) require that the low calibration is a true zero calibration adjustment. For these sensors, a gas with a known zero concentration of the target gas should be used. For other sensors where the low calibration adjustment is not restricted, a high and low calibration adjustment value should be selected. The selected gas concentrations should best reflect the range over which the sensor is intended to be used for greater reading accuracy.

For calibration of standard ACG+ sensor parts, the following gas mixes are recommended. Factory configurations for each ACG+ contain the calibration information for these gas mixes which can be used for ease of repeat calibration. These values can be modified if alternative mixes are used.

Table 7 Recommended calibration gas concentrations

Sensor	Recommended low calibration concentration	Recommended high calibration concentration
O_2	0 to 10% O_2	20 to 25% O_2
CO_2	0ppm CO_2	800 to 1000ppm CO_2
VOC	0ppm VOC	15 to 20ppm isobutylene (C_4H_8)
CO	0ppm CO*	15 to 20ppm CO
H_2O	Not for user calibration	Not for user calibration

*When performing a zero calibration of carbon monoxide (CO), due to the nature of the CO cell chemistry, a small amount of oxygen (>100ppm O_2) should be present in the calibration gas mix in order to ensure maximum sensor accuracy.

Note:
When calibrating the CO sensor, care should be taken when selecting the calibration gas used. The balance or background gas can have an effect on the sensor reading as explained in section 5.10.1.

Note:
When calibrating the CO_2 sensor, care should be taken when selecting the calibration gas used. The balance or background gas can have an effect on the sensor reading, if calibrating with a nitrogen balance gas and the sensor is then shown a helium balance gas after calibration, the sensor will read considerably lower. If calibrated with a helium balance gas and the sensor is then shown a nitrogen balance gas after calibration, the sensor will read considerably higher.

Select the calibration balance gas to match the intended background gas to be measured.

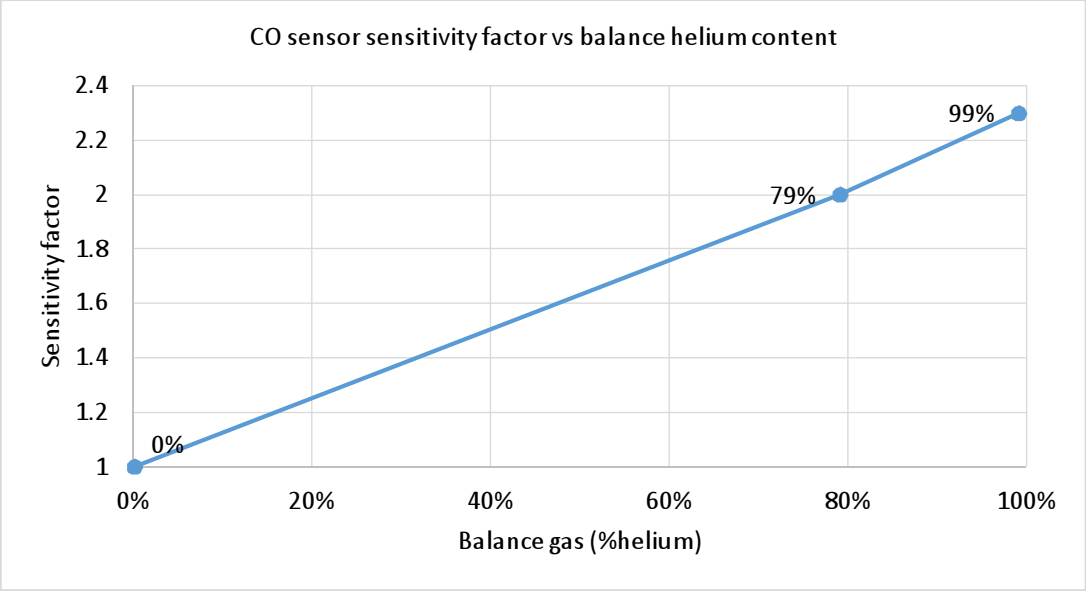
5.10.1 CO sensor characteristics in the presence of helium

The carbon monoxide sensor is a capillary type sensor. This type of sensor is affected by the presence of helium. When exposed to a gas containing significant amounts of helium the sensor will over-read.

The reason for this phenomenon, is down to the small size of the helium molecule compared to other molecules present (mostly nitrogen and oxygen molecules). The helium molecules diffuse more rapidly through the capillary into the sensor, allowing more capacity for the larger carbon monoxide (CO) molecules to enter the sensor. More CO molecules in the sensor results in a stronger electrochemical reaction and an artificially high reading.

The size of the over reading is dependent upon the amount of helium present. As a worst case, an instrument calibrated on an air balanced gas, will over-read by a factor of 2.3 if exposed to a helium balanced gas. This means that the instrument will read 4.6ppm when exposed to 2ppm CO gas.

The following graph approximately shows how the over-read factor varies with Helium concentration:



This over-reading can be removed by calibration. For the best accuracy of CO measurement, calibrate the instrument with gases that closely match the balance gas that will be measured in your application. I.e. if the measured gas contains 99% Helium and 1% O2, a calibration gas containing 18ppm CO, 1% O2 and helium balance will give the greatest accuracy of measurement. It should be noted that this correction only works while the measured balance gas remains the same as the calibration gas

Warning: In the same way as a sensor over-reads when calibrated in air and exposed to helium. An instrument calibrated in helium will under-read when exposed to air. In some applications it is normal for the balance gas to change during operation. Care must be taken to ensure that the alarms will trigger at the correct level of CO for all levels of balance gas expected. This is to ensure the safety of those breathing the gases. For example if the instrument is calibrated on a helium balance gas, a significantly higher concentration of CO will be required to trigger the alarms if the balance gas measured is air.

For this reason Analox recommend, that a gas that is air balanced (18ppm CO, air balance) is best, as this offers safe triggering of alarms regardless of the gas being measured. The alarms will trigger early when exposed to helium balanced gases, however this is normally considered to be a safe situation.

5.10.2 Performing an adjustment

WARNING: Before a calibration gas is applied to the ACG+, ensure that the sample gas has been isolated and sample/calibration adaptor has been removed from the ACG+ inlet.

Calibration gas flow should be set at 0.5l/m. This is best achieved by using the gas flow regulator accessory (see section 8**Error! Reference source not found.**) which is pre-set at 0.5l/m.

Note: For best results, the ACG+ sensors should be calibrated with the low calibration mix first, followed by the high calibration mix.

Note: Whilst the ACG+ is exposed to calibration gas, alarms may be triggered. Set the safety interlock key-switch (if fitted on fixed version) to override if alarms are likely to cause unwanted disruptions to attached equipment.

To perform a calibration adjustment, first expose the sensors to the appropriate calibration gas of known concentration via the sample/calibration gas inlet as follows:

- Fit the 0.5 LPM gas flow regulator accessory (see section 8) or suitable regulator to the calibration gas bottle (Figure 24).

Figure 24 - Flow regulator fitted to calibration bottle

- Connect the outlet of the regulator to the inlet/calibration gas connector accessory (see section 8) and then connect the inlet/calibration gas connector to the calibration inlet on the ACG+ (Figure 25). Push the fitting on fully until it latches in place.

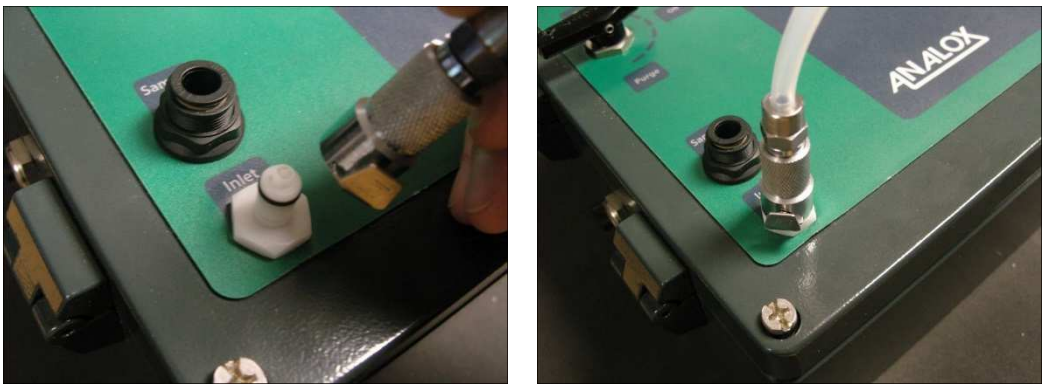


Figure 25 - Connecting calibration fitting to ACG+ calibration port

- Open the valve on the flow regulator attached to the bottle and then open the inlet valve on the front panel. The ACG+ should register that there is flow to the sensors.

- Allow 5 minutes for the sensors to settle to stable readings on the calibration gas.
- To perform an adjustment, from the main menu select 'Calibration' then select the bottle that is currently attached. The calibration adjustment screen will be shown (Figure 26).

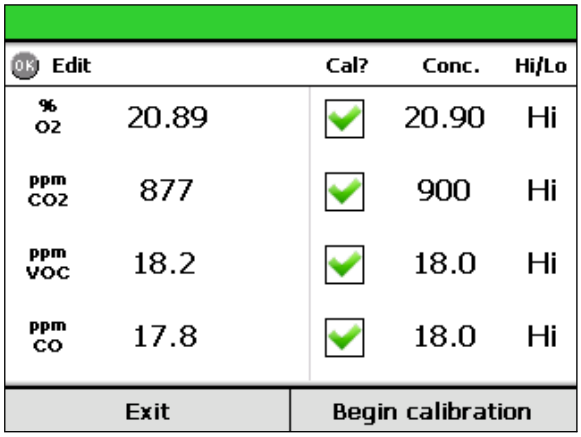


Figure 26 - Calibration adjustment screen showing high calibration bottle

- The values on the left show the current sensor readings. (Note that it is possible for sensors to show negative readings when exposed to zero gas in this situation. This is likely when attempting to measure values close to zero).
- The calibration bottle details are shown on the right. (If the values shown are not correct for the bottle attached, the values can be changed. See section 5.10.4).
- The calibration details also show the type of calibration (low or high) which will be performed for the selected bottle.
- Calibration details will not be shown for all sensors. Certain sensors that cannot be user adjusted are excluded such as the H_2O sensor.
- If not all sensors shown are to be adjusted, sensors can be excluded from the adjustment (see section 5.10.3).
- To begin a calibration adjustment, press the 'Begin calibration' context button.
- For each sensor marked for adjustment, a rotating progress symbol will be shown whilst each sensor works out whether the adjustment is valid.
- After a short delay the result of the adjustment will be shown (Figure 27). If the adjustment was successful, a green icon will be shown. If the adjustment was not successful, a red icon will be shown. For troubleshooting of failed adjustments see section 7.1.3

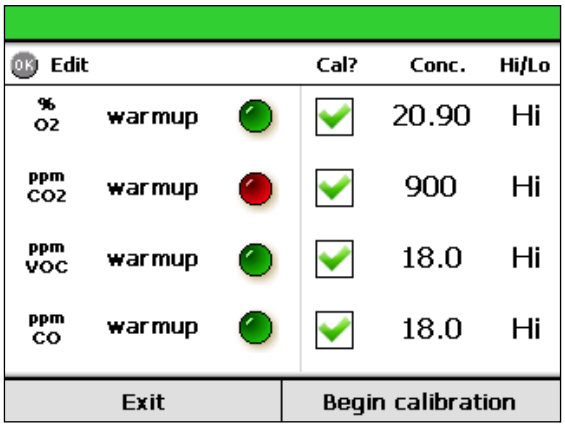


Figure 27 - Calibration adjustment results - CO_2 sensor failed to adjust

- After any calibration adjustment request is processed, the sensors may enter a warm-up state for a few seconds during which time the sensor reading will not be available.
- Allow the sensors 1 minute to stabilise after calibration and check that the readings shown are reasonable for the calibration gas applied.
- To finish, close the valve on the bottle flow regulator and close the inlet valve on the front panel then disconnect the calibration connector from the ACG+ by pressing the release catch and gently removing.

- Repeat for a high calibration as necessary. (Note that both low and high calibration adjustment should be performed in order to reset calibration due notifications).

5.10.3 Excluding sensors from calibration adjustment

- When performing an adjustment, individual sensors may be excluded so that only certain sensors are adjusted.
- To exclude sensors press ‘OK’ whilst the calibration screen is shown to allow sensor selection. Use the up and down buttons to select a sensor to exclude.
- To exclude the highlighted sensor, press the ‘Enable/Disable’ context button. The excluded sensor will be unchecked and greyed out (Figure **28**).
- To re-enable the sensor for adjustment, press the ‘Enable/Disable’ context button again. This can be repeated for multiple sensors.
- To exit editing mode so that the adjustment can be performed, press the ‘Exit Edit’ context button.

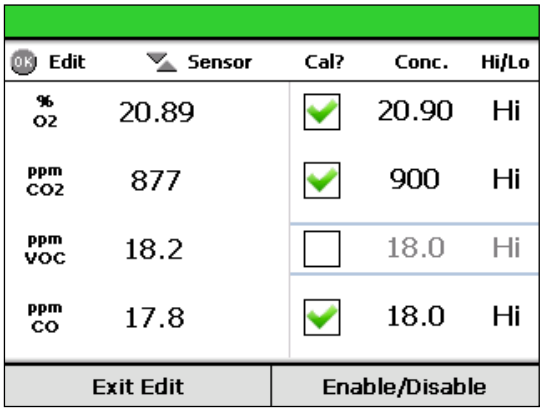


Figure 28 **- Excluding the VOC sensor from the calibration adjustment**

5.10.4 Editing calibration bottle values

By default, the ACG+ has two calibration bottles defined. If you are using a calibration bottle which has values which are slightly different from the bottle values defined, it is possible to change the bottle values to match the gas bottle to be used.

- To change a calibration value, press 'OK' whilst the calibration screen is shown to allow sensor selection.
- Use the up and down buttons to select a sensor to change.
- To change the highlighted sensor's value, press 'OK'. The sensor's calibration value will be highlighted (Figure 29).
- Press the up and down buttons to change the calibration value (press and hold the button to adjust the value more rapidly).
- When the desired value is shown, press 'OK' to set the value. Repeat for any other calibration values which need to be changed.
- When finished, press the 'Exit Edit' context button to return to the calibration screen and allow a calibration adjustment to be performed.

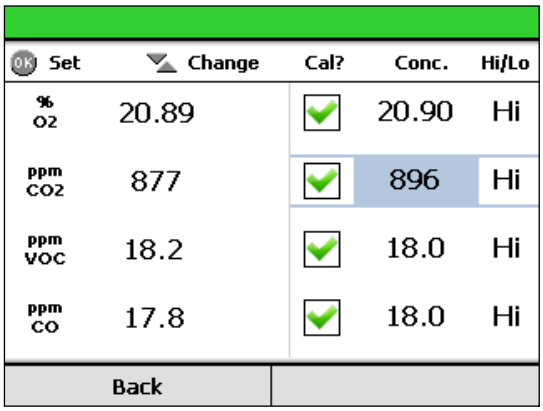


Figure 29 - Adjusting the CO_2 calibration value

5.10.5 Calibration adjustment reminders

When enabled, the ACG+ will show a flashing reminder beside the sensor reading when a calibration adjustment is due (Figure 30). The reminder is displayed when the time since the last full high and low calibration adjustment was performed exceeds the required calibration regime.

A calibration adjustment reminder will only be cleared once both a high and low calibration adjustment have been performed. Both adjustments should be performed with as little time between as possible. If not performed together, the calibration adjustment reminder will be shown based on the time of the earlier of the two adjustments.

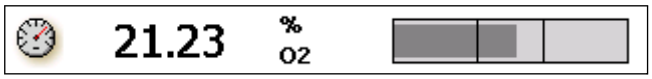


Figure 30 - A calibration adjustment reminder

The sensor calibration due date can be viewed on the sensor information screen (section 5.12)

5.11 Viewing device information

For ease of access, the device information screen can be accessed from the main sensor readings screen by using the right hand context button. Alternatively, to view information about the system, select 'System information...' from the main menu. This will display the device information screen (Figure 31). The system information page shows the serial number of the device, information about the software version and the current date and time. Readings are also shown for the current (absolute) inlet pressure, the absolute atmospheric pressure and the flow rate of sample gas to the sensors.

The sensor reading screen can be accessed from the device information screen by pressing the right hand context button. This allows for quickly toggling between the two screens when taking measurements.

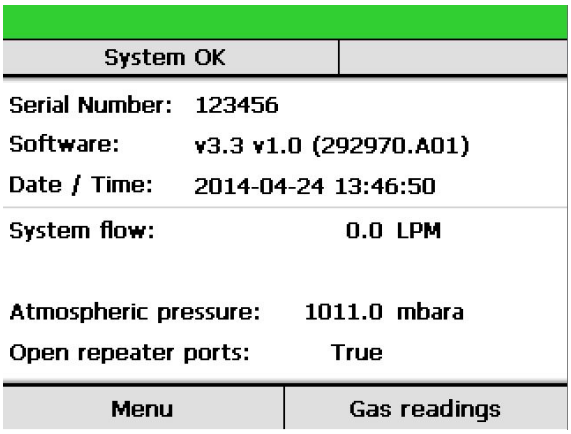


Figure 31 - The device information screen

5.12 Viewing sensor information

To view information about an individual sensor, select 'Sensor options' from the main menu and then select the sensor of interest. Next select the 'Sensor info...' option. The sensor information screen will be shown (Figure 32).

The sensor information screen shows the serial number, part number and a diagnostic code for the chosen sensor. If calibration reminders apply to the particular sensor (section 5.10.5), the date when calibration is next due will be shown. Likewise, if the sensor or an element of the sensor requires routine replacement (section 5.14), the date when the replacement is next due will be shown. The sensor information screen also shows the alarms that are currently applied to the sensor including direction and set-point.

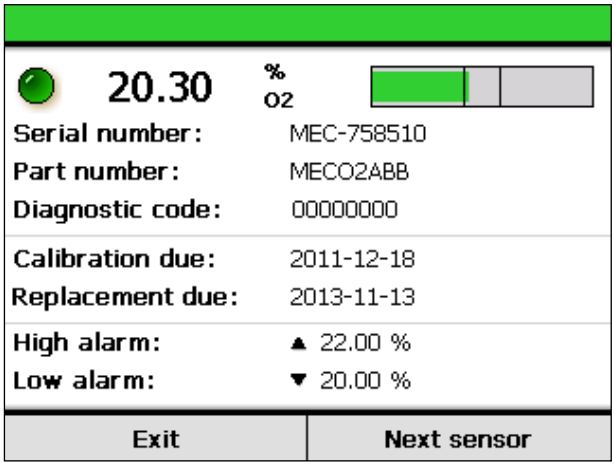


Figure 32 - Sensor information screen for O_2

From the sensor information screen, information about the next sensor in the list can be easily displayed by pressing the 'Next sensor' context button.

5.13 Data-logging

If the data-logging feature is enabled on an ACG+ then it will maintain a log of system and sensor data whenever the device is powered up. Data is logged every 10 seconds and includes the system status, average, minimum and maximum readings for the 10 second period for each sensor. An ACG+ operates a 90 day rolling log. Once 90 days' worth of data is collected, the oldest day's data will be deleted so only the most recent 90 days are recorded.

Data can be downloaded into daily log files in .CSV (comma-separated values) format for easy import into popular spreadsheet applications. An example of a typical data log file is shown below. (Note that only the first sensor data is shown here. Average, minimum and maximum readings and units for each sensor will be logged).

Table 8 Data-log formatting example

Date	Time	Flow(LPM)	Inlet pressure (mbara)	Atm pressure (mbara)	Temp (C)	O2 Units	O2 Average	O2 Max	O2 Min	...
08/12/2011	10:08:00	0.53	5463.1	1013.1	27.1	%	20.92	20.93	20.91	...
08/12/2011	10:08:10	0.53	5463.4	1012.9	27.1	%	20.91	20.93	20.91	...
08/12/2011	10:08:20	0.52	5463.2	1013.0	27.1	%	20.35	20.92	19.69	...
08/12/2011	10:08:30	0.53	5463.0	1013.1	27.1	%	20.91	20.93	20.91	...
08/12/2011	10:08:40	0.54	5463.2	1013.2	27.1	%	20.92	20.93	20.91	...

Note: If a sensor is in a state where a valid reading cannot currently be show (such as warm-up or certain faults) then a blank entry will be recorded in the data log.

5.13.1 Retrieving data-logs

There are two methods of downloading data-logs. To view all of the log files which are available on the system, download and delete specific logs, the ACG+ PC Software can be used as described in section 6.4.

Alternatively, for convenience, the full set of data-log files can be downloaded from the device, directly onto a USB memory stick via the USB port on the front panel. To download the data logs, prepare a USB memory stick, ensuring that there is enough space free to download logs. Each daily log file is typically 1.5MB in size, with a full 90 days of logs taking up approximately 135MB.

WARNING: When downloading logs via this method, the logs will be stored automatically at the root of the USB memory stick in a folder named by ACG+ serial number and date of download. Ensure that any important files that might be stored on the USB memory stick are backed up to another device before attempting a download.

Once the USB memory stick is ready for downloading logs, unscrew the protective cover from the USB socket on the front panel of the ACG+ and insert the USB memory stick into the USB socket.

From the main menu, enter the 'Data-logging' sub-menu and select 'Download data to USB...'. The data-log download screen will be shown (Figure 33). This will indicate how many logs are available to be downloaded. If there is insufficient space on the USB memory stick to download all log files then an error will be shown.

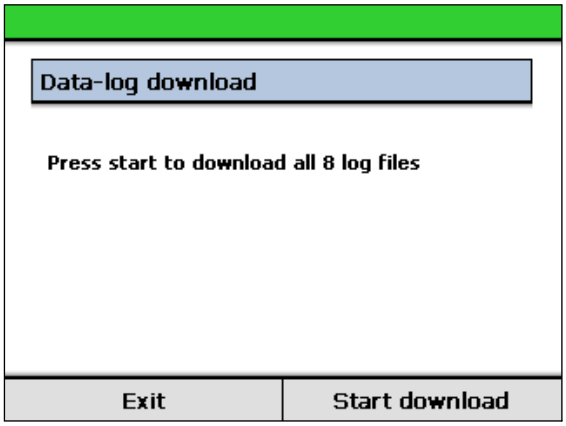


Figure 33 - Data-log download screen

To begin the download, press the 'Start download' context button. The progress of the download will be shown on screen (Figure 34). The download may take several minutes depending on the number of files currently stored.

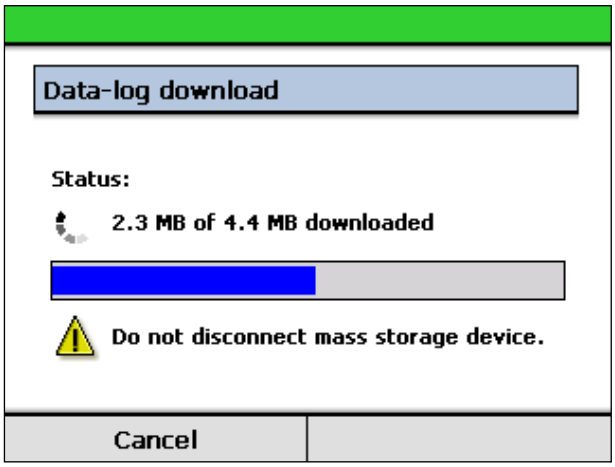


Figure 34 - Data-log download in progress

WARNING: It is important that once a log download has begun, the USB memory stick is not disconnected from the ACG+. Unexpected removal of the USB device may corrupt the device's memory and important data may be lost.

The data-log download screen will indicate that the download is complete once all data-logs have been downloaded.

The download can be cancelled at any time by pressing the 'Cancel' context button. It may take a few seconds to cancel the download once requested. The USB device should remain connected until the display shows that the download has been successfully cancelled. When a download is cancelled, all full data-log files that have been downloaded up until the point of cancellation will remain on the USB memory stick.

Each time a log download is performed in this way, all files will be downloaded. To avoid having to download all data-logs each time, an option to delete all current data-logs exists so that after a download, the logs may be cleared. To delete all log files, select 'Data-logging' from the main menu and then select 'Delete all data-logs'. Confirmation is required before the logs will be deleted. Note that this operation is permanent and logs that are deleted cannot be retrieved at a later date.

5.14 Sensor replacement reminder

Certain ACG+ sensors have a requirement to be periodically replaced or have elements of the sensor replaced, for example, to replace a depleted electrochemical cell or to return for factory calibration. To aid with the timely replacement and/or maintenance of sensors the ACG+ provides a sensor replacement reminder feature. This feature is only effective for sensors which require periodic replacement and/or maintenance.

If the sensor is replaceable, the ACG+ will show an onscreen warning when the sensor/cell is due to be replaced as shown in Figure 35. The sensor/cell replacement reminder is shown once the number of days that have elapsed since the cell was last replaced exceeds the sensor/cell replacement reminder period. The sensor replacement due date can be viewed on the sensor information screen (5.12)

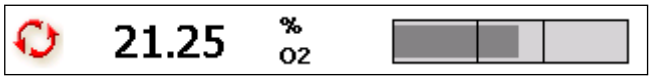


Figure 35 - Sensor change reminder

Note: The cell replacement feature is intended to be used only as a guide and cannot accurately determine the lifespan of a cell. If a sensor becomes difficult to calibrate after a period of time in service then it should be replaced regardless of the reminder status.

5.14.1 Replacing a cell and resetting the reminder

The sensor replacement reminder does not automatically reset once a sensor has been replaced. Once a sensor or cell has been physically replaced, the sensor/cell replacement reminder will continue to be shown and needs to be manually reset. To do this, open the main menu, select 'Sensor options' and the select the sensor that has been replaced. From the sensor's sub-menu select 'Replacement reset....'. A confirmation screen will be shown explaining the implications of resetting the reminder (Figure 36). On pressing the 'Confirm' context button, the sensor will store the current date as the date it was last replaced.

WARNING: Once the reminder has been reset for a sensor, a reminder will not be shown again until the sensor is next expected to be replaced. The reset feature should only be used if the sensor has been physically replaced.

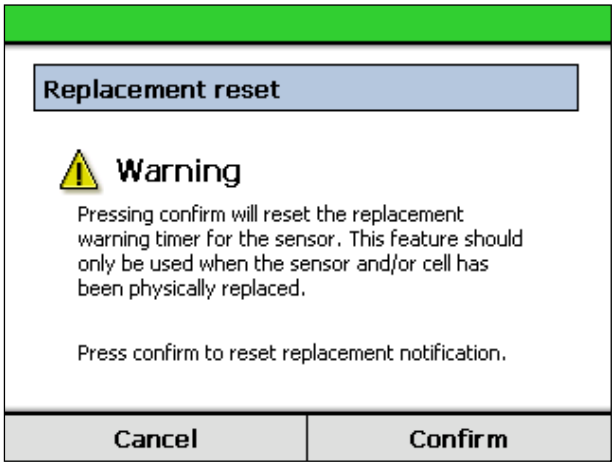

Replacement reset
Warning
Pressing confirm will reset the replacement warning timer for the sensor. This feature should only be used when the sensor and/or cell has been physically replaced.
Press confirm to reset replacement notification.
Cancel
Confirm

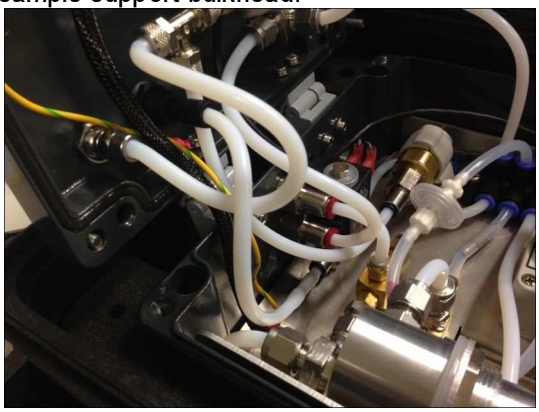
Figure 36 - Sensor replacement reset confirmation screen

5.15 Timed sample draw

Occasionally it may be desirable to take a sample of the ACG+ inlet gas and direct it into another gas detection device or analysis tube, for example, when analysing oil mist content. The ACG+ provides a method of drawing off a sample of the inlet gas via a software controlled sample valve. This feature can be used to set up a timed sample with a known flow which will automatically end after the defined timeout. Note that the sample draw bypasses all system filtering.

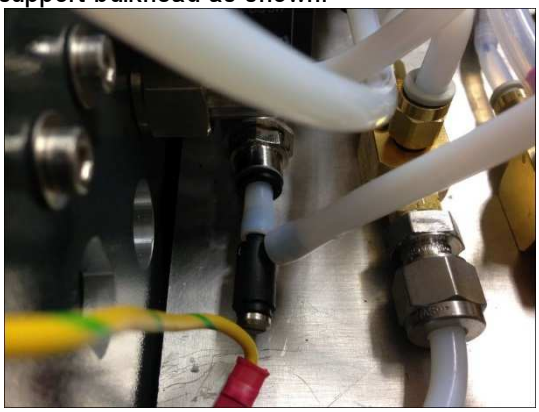
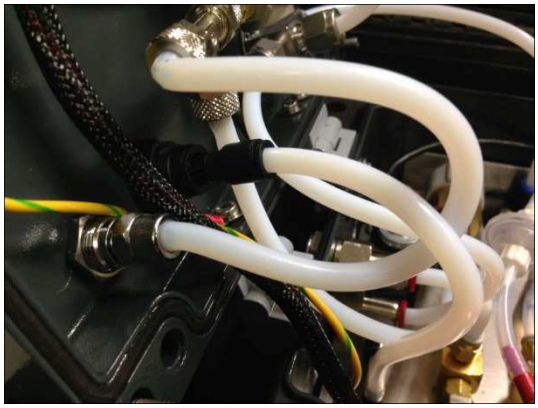
The ACG+ comes fitted with a fixed restriction prior to the sample outlet port suitable for oil mist detection using a Drager Impactor. Another restrictor kit is supplied which can be quickly fitted to provide suitable flows, for example for an Oilmist colourmetric tube (0.1l/m sample for 3 minutes).

- Remove the Impactor restrictor tube from the outlet of the solenoid valve and the rear of the sample support bulkhead.



- Remove the 8mm to 6mm push reducer from the Impactor restrictor tube and fit it to the 0.1l/m restrictor tube.

- Refit the 0.1l/m restrictor tube to the outlet of the solenoid valve and the rear of the sample support bulkhead as shown.

A flow meter kit (1 to 10l/m) is also available as an accessory (P0149-611) which can be fitted to the sample gas outlet port to provide a suitable flow for other sampling techniques.

The procedure for performing a timed sample draw is as follows:

- Attach the target gas to the sample inlet and the measurement device or sample pipe to the gas outlet port on the ACG+ front panel (see Figure 37).
- In the example shown below (Figure 37) the protection label on the Dräger Impactor should be removed.

Figure 37 - A Dräger Impactor attached to the outlet port for oil mist testing

- From the main menu select 'Timed sample' then select 'Start new sample…'. The timed sample setup screen will be shown (Figure 38).

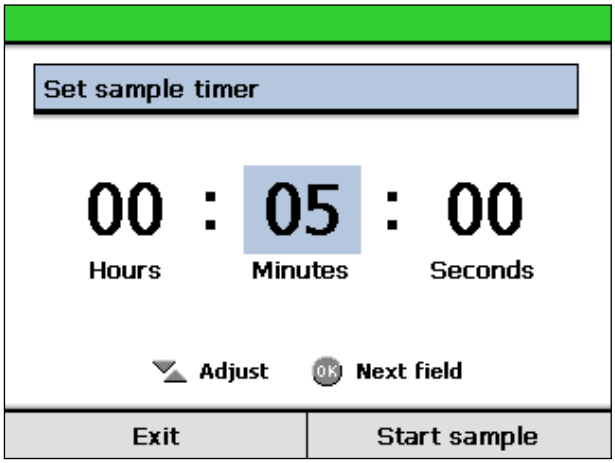


Figure 38 - Timed sample setup

- Select the highlight hours/minutes/seconds field by pressing the 'OK' button and use the up and down buttons to dial in the desired sample time.
- Press 'Start sample' to begin the timed sample. The sample valve will then open.
- Throughout the sample period, the time remaining on the sample timer will be shown on the screen (Figure 39).
- When the sample is complete, the ACG+ will give three beeps and the sample valve will close. The main screen shall show that the sample is complete (Figure 39).

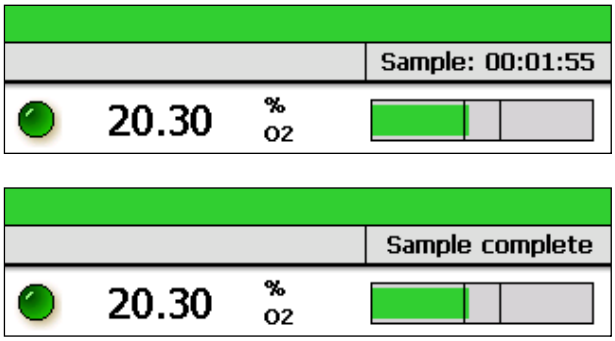


Figure 39 - Timed sample progress

A timed sample can be cancelled at any time whilst it is in progress. To cancel a sample, select 'Timed sample' from the main menu and select 'Cancel sample'.

For certain sampling applications, it may be necessary to purge the sample line prior to beginning a sample. The simplest way to achieve this is to use the purge valve as described in section 5.3.1.

5.16 Setting the date and time

The current date and time are stored on the device. This allows the ACG+ to log data with a date and time stamp and also allows calibration and sensor replacement reminders to be given. The date and time can be set or changed through the main menu under 'System options>Set date and time…'.

Figure 40 shows the date and time adjustment screen. To adjust the highlighted field, press the up and down buttons. To highlight the next field, press the set button. Once the correct date and time is shown, press the 'Accept' context button to save the date and time.

Alternatively, the date and time can be set using the PC tool (see section 6.5).

Figure 40 - Date and time adjustment screen

6 Configuration

In order to set options on an ACG+, the ACG+ software is provided to allow a device to be configured using a USB connection. The ACG software is designed to run on Microsoft Windows®.

6.1 Software installation

Note: Before connecting an ACG+ to a computer, the appropriate software should be installed.

6.1.1 Software requirements

The ACG+ software is designed to run on Microsoft Windows® and has the following prerequisites:

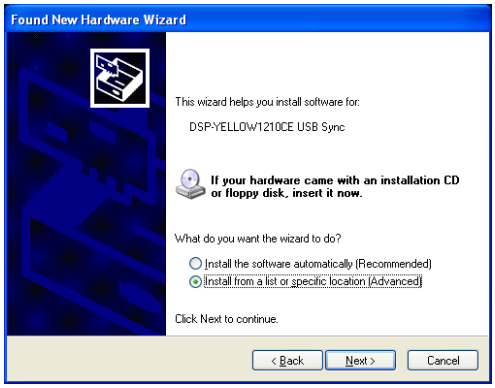
- Microsoft Windows XP®, Windows Vista®, Windows 7® or Windows 8®
- Microsoft .NET Framework 3.5 SP1 or later
- Microsoft ActiveSync® 4.5 or later (Windows XP® only)
- Microsoft Windows Mobile Device Centre 6.1 or later (Windows Vista® & Windows 7® only)

6.1.2 Windows® XP Installation

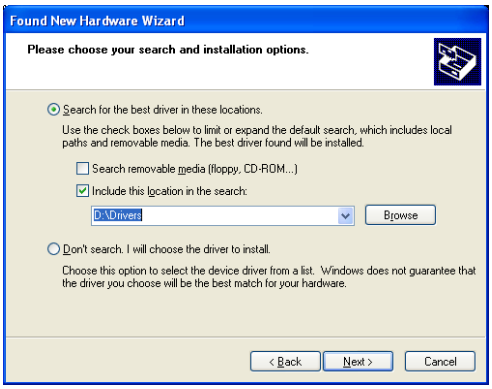
To install the ACG+ software on Windows XP®, perform the following steps.

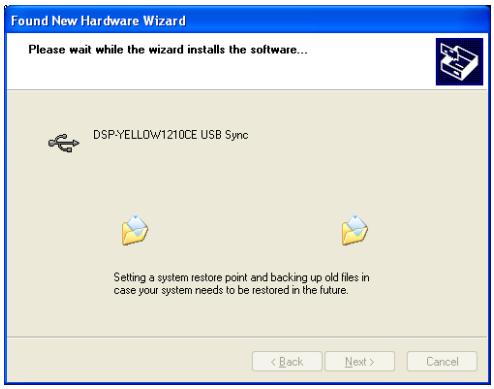
1) Unplug all unnecessary USB devices from the computer.
2) If not already installed, install Microsoft ActiveSync® 4.5 or later. This software is available as a free download from the **Microsoft Download Centre**
3) If installing from the ACG software CD, insert the disc into the CD drive.
4) Connect the ACG+ to the computer using the USB cable (see 6.2) and switch on the ACG+.
5) Windows will pop up a message stating that it has found new hardware.
6) The 'Found New Hardware Wizard' window will be shown.
7) Select 'No, not this time' and click 'Next'.
8) On the next screen, select 'Install from a list or specified location (Advanced)' and click next.

Found New Hardware Wizard
Welcome to the Found New Hardware Wizard
Windows will search for current and updated software by looking on your computer, on the hardware installation CD, or on the Windows Update Web site (with your permission).
Read our privacy policy
Can Windows connect to Windows Update to search for software?
Yes, this time only
Yes, now and every time I connect a device
No, not this time
Click Next to continue.
< Back
Next >
Cancel


Found New Hardware Wizard
This wizard helps you install software for:
DSP-YELLOW1210CE USB Sync
If your hardware came with an installation CD or floppy disk, insert it now.
What do you want the wizard to do?
Install the software automatically (Recommended)
Install from a list or specific location (Advanced)
Click Next to continue.
< Back
Next >
Cancel

9) On the next screen, select 'Search for the best drivers in these locations', uncheck 'Search removable media' and check 'Include this location in the search.
10) Click 'Browse' and locate the ACG+ driver folder. This will be the folder named 'Drivers' on the ACG software disc. Click 'Next' to begin installation.
11) The ACG+ drivers will be installed. This may take a few moments. When the installation is complete, click 'Finish'.
12) Make sure the ACG+ is disconnected from the computer
13) Go to the folder C:\Program Files\Microsoft ActiveSync\Drivers and look for the file called wceusbsh.sys
14) Select this file, copy it and paste it into the following folder C:\Windows\System32\drivers
15) Restart the computer
16) Repeat steps 4) to 11) to reinstall the ACG+ driver then go to step 17).
17) The device should automatically connect to ActiveSync and may pop up the ActiveSync window. This window can be closed.


Found New Hardware Wizard
Please choose your search and installation options.
Search for the best driver in these locations.
Use the check boxes below to limit or expand the default search, which includes local paths and removable media. The best driver found will be installed.
Search removable media (floppy, CD-ROM...)
Include this location in the search:
D:\Drivers
Browse
Don't search. I will choose the driver to install.
Choose this option to select the device driver from a list. Windows does not guarantee that the driver you choose will be the best match for your hardware.
< Back
Next >
Cancel

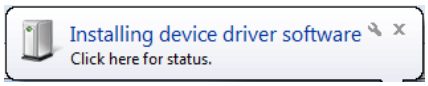

Found New Hardware Wizard
Please wait while the wizard installs the software...
DSP-YELLOW1210CE USB Sync
Setting a system restore point and backing up old files in case your system needs to be restored in the future.
< Back
Next >
Cancel

18) From the ACG+ software disk, run the installer file called 'Setup'.
19) The installer will check that the .NET Framework 3.5 SP 1 is installed. If not you will be prompted to allow the framework to be installed. Alternatively the .NET Framework is available as a free download from the **Microsoft Download Centre**
20) Once the installer is satisfied that the .NET Framework is installed, the ACG+ installer wizard will be displayed. Follow the on-screen instructions to install the ACG software.

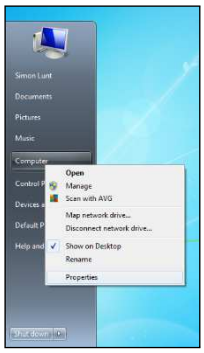
6.1.3 Windows® Vista & Windows® 7 Installation

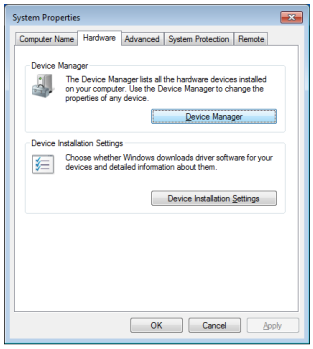
To install the ACG+ software on Windows® Vista or Windows7 ®, perform the following steps.

1) Unplug all unnecessary USB devices from the computer.
2) If not already installed, install Microsoft Windows Mobile Device Centre 6.1 or later for the appropriate version of Windows. This software is available as a free download from the **Microsoft Download Centre**. Ensure that the appropriate 32bit or 64bit download is selected for your version of Windows®.
3) If installing from the ACG+ software CD, insert the disc into the CD drive.
4) Connect the ACG+ to the computer using the USB cable (see section 6.2) and switch on the ACG+.
5) Windows will pop up a message box stating that it is attempting to install drivers. Windows will fail to find drivers for the device.



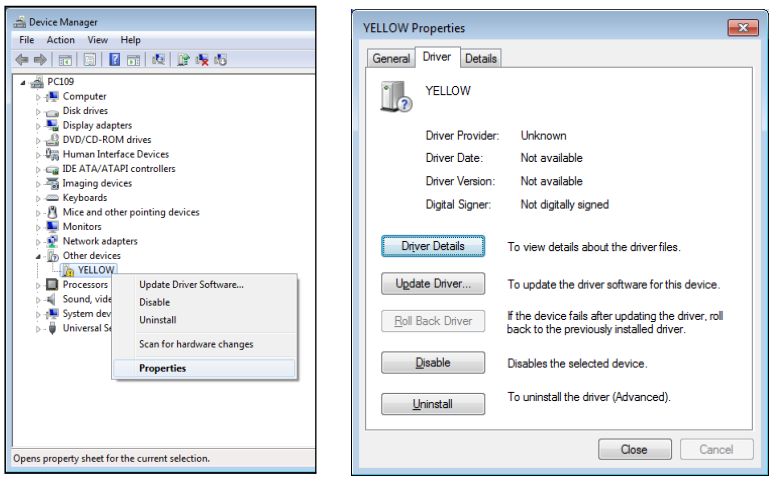
6) Access the system properties window by clicking on the Windows start menu, right-clicking on 'Computer' and selecting properties.
7) On the system properties window, click 'Advanced system settings'.
8) Select the 'Hardware' tab and click 'Device Manager'.



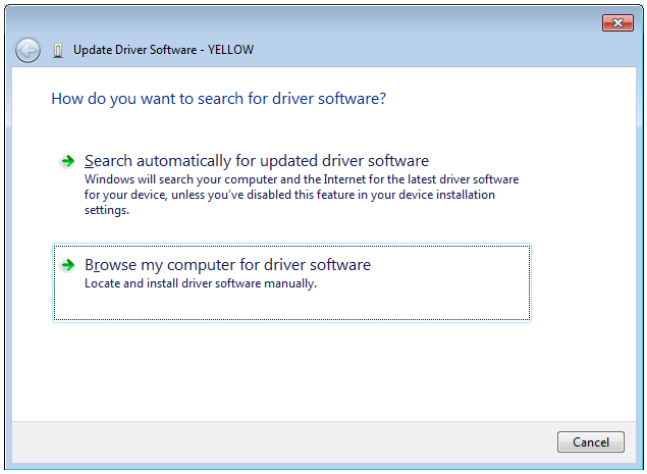


9) In the device manager window, locate 'YELLOW' under 'Other devices'. Right click this and select 'Properties'.

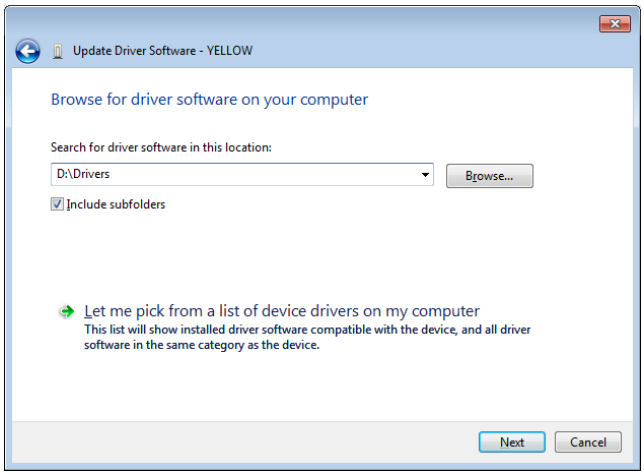
10) Select the ‘Driver’ tab and click ‘Update Driver…’.



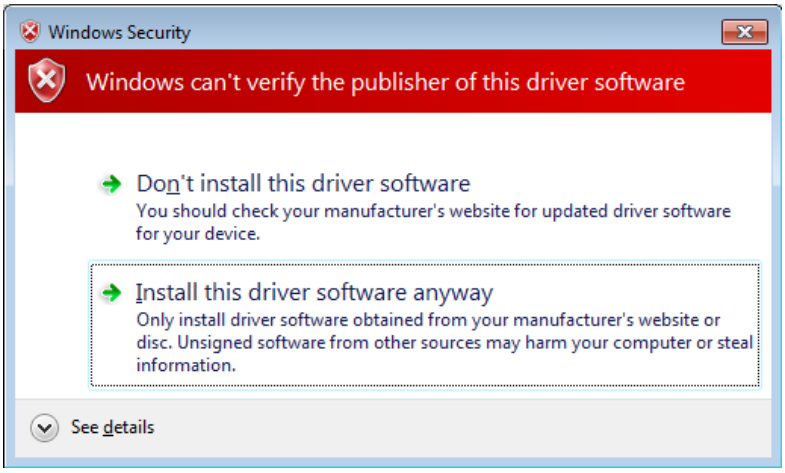
11) Click ‘Browse my computer for driver software’.


Update Driver Software - YELLOW
How do you want to search for driver software?
Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.
Browse my computer for driver software
Locate and install driver software manually.
Cancel

12) Click ‘Browse’ and locate the ACG+ driver folder. This will be the folder named ‘Drivers’ on the ACG+ software disc. Click ‘Next’.


Update Driver Software - YELLOW
Browse for driver software on your computer
Search for driver software in this location:
D:\Drivers
Browse...
Include subfolders
Let me pick from a list of device drivers on my computer
This list will show installed driver software compatible with the device, and all driver software in the same category as the device.
Next
Cancel

13) Click ‘Install this driver software anyway’ when prompted.


Windows Security
Windows can't verify the publisher of this driver software
Don't install this driver software
You should check your manufacturer's website for updated driver software for your device.
Install this driver software anyway
Only install driver software obtained from your manufacturer's website or disc. Unsigned software from other sources may harm your computer or steal information.
See details

14) The ACG+ driver will then install.
15) When complete, the Windows Mobile Device Centre main window may pop up. This window can be closed. Accept the Windows Mobile Device Centre user agreement if prompted.
16) From the ACG+ software disk, run the installer file called 'Setup'.
17) The ACG+ installer wizard will be displayed. Follow the on-screen instructions to install the ACG software.

6.1.4 Windows® 8 Installation

6.1.4.1 Installing Windows Mobile Device Centre

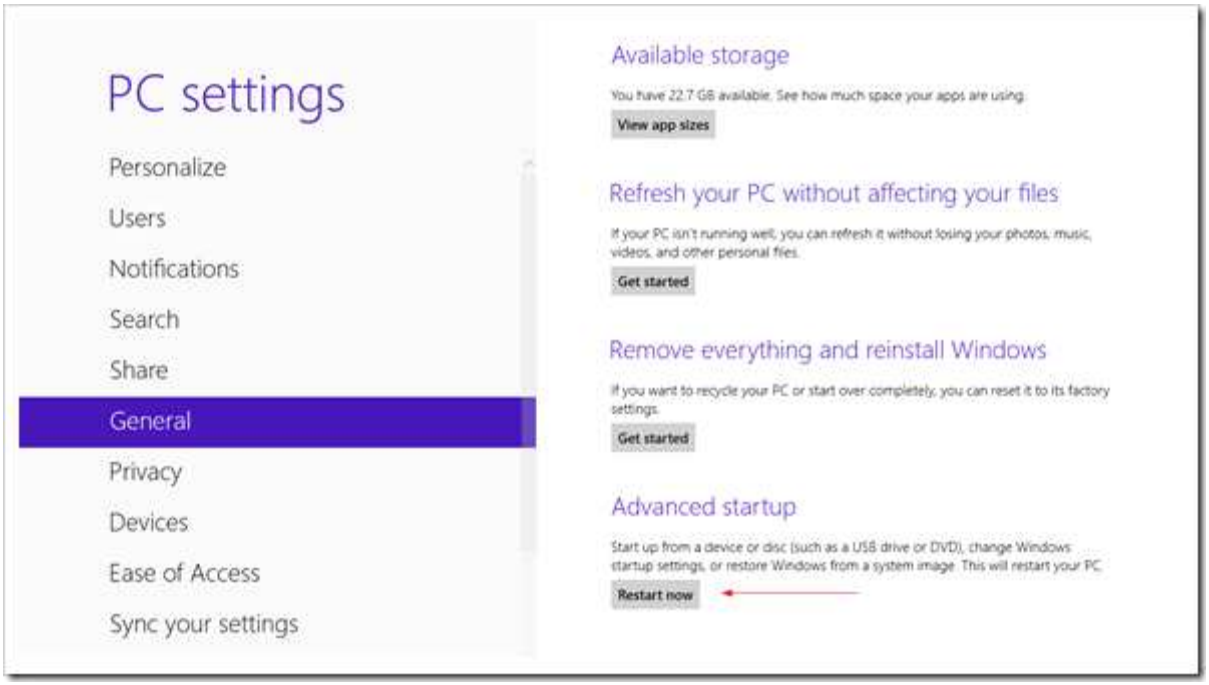
To install the ACG+ software on Windows® 8, perform the following steps.

1) Unplug all unnecessary USB devices from the computer keeping the ACG+ plugged in.
2) If not already installed, install Microsoft Windows Mobile Device Centre 6.1 or later for the appropriate version of Windows. This software is available as a free download from the **Microsoft Download Centre**. Ensure that the appropriate 32bit or 64bit download is selected for your version of Windows®.

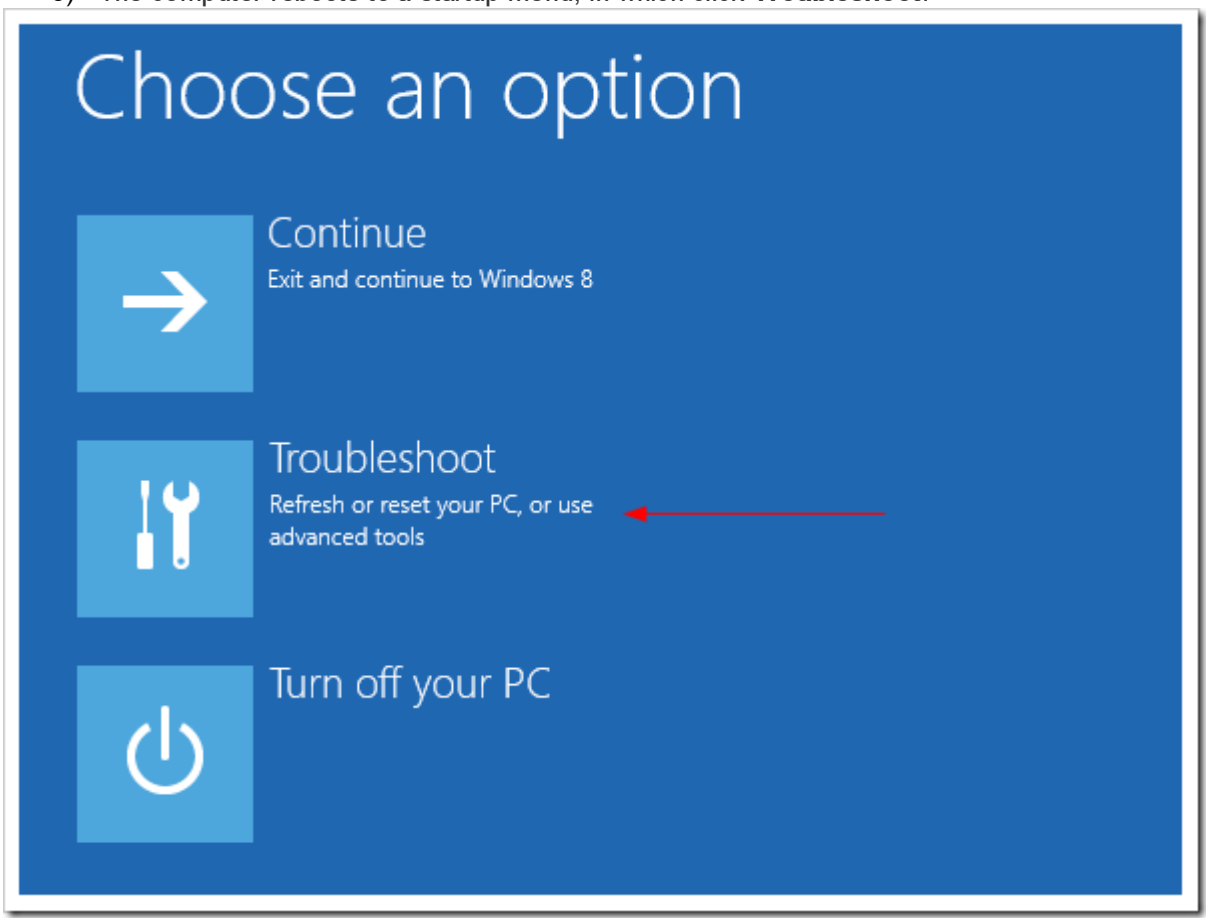
6.1.4.2 Disabling driver signature enforcement

1) First, press **win + I** to launch the charm bar, and click **Change PC Settings** at the bottom.

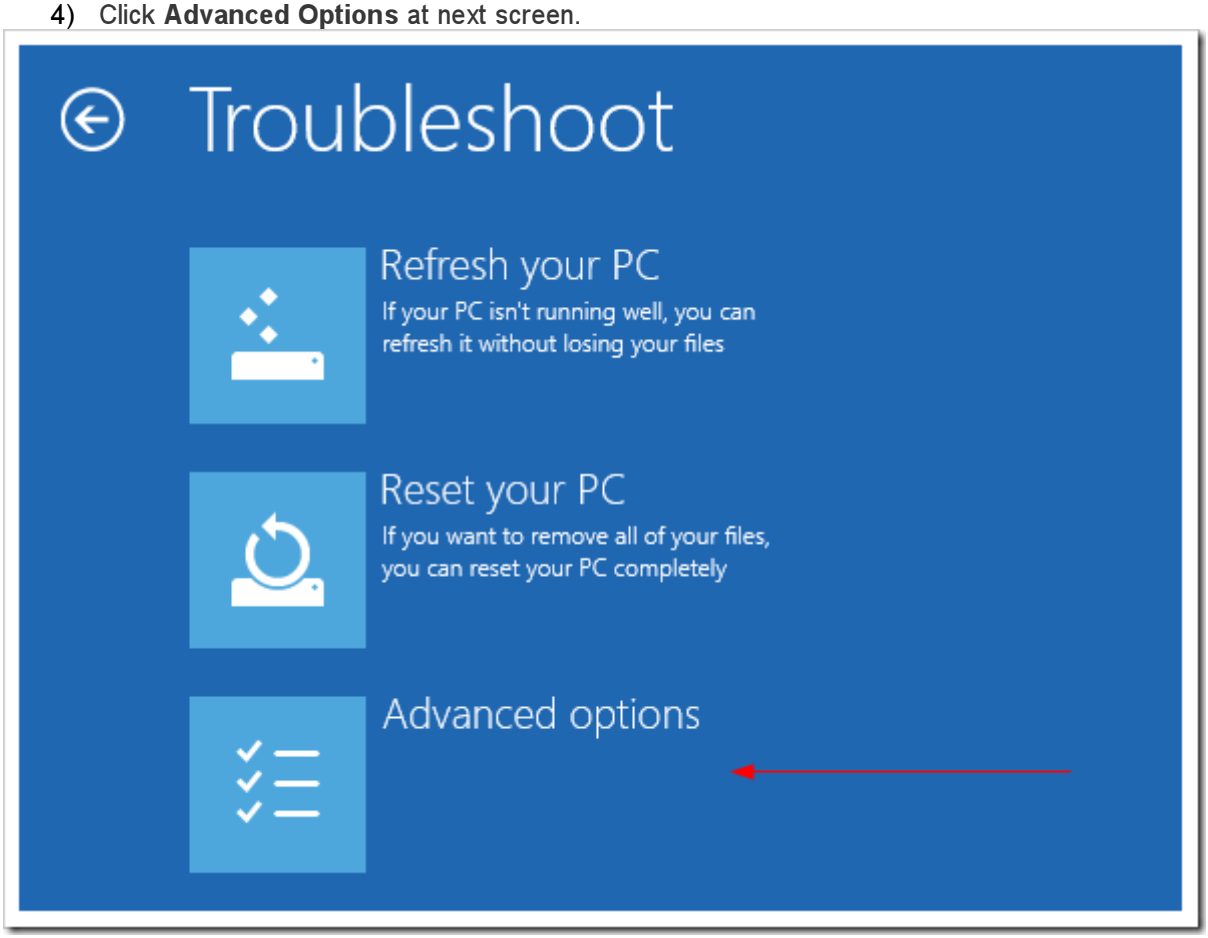
2) Then, go to **General**, and scroll to the bottom of the page, on the right hand side click **Restart Now** button under **Advanced Startup** section. Remember to save all your work first before clicking it.


PC settings
Personalize
Users
Notifications
Search
Share
General
Privacy
Devices
Ease of Access
Sync your settings
Available storage
You have 22.7 GB available. See how much space your apps are using.
View app sizes
Refresh your PC without affecting your files
If your PC isn't running well, you can refresh it without losing your photos, music, videos, and other personal files.
Get started
Remove everything and reinstall Windows
If you want to recycle your PC or start over completely, you can reset it to its factory settings.
Get started
Advanced startup
Start up from a device or disc (such as a USB drive or DVD), change Windows startup settings, or restore Windows from a system image. This will restart your PC.
Restart now

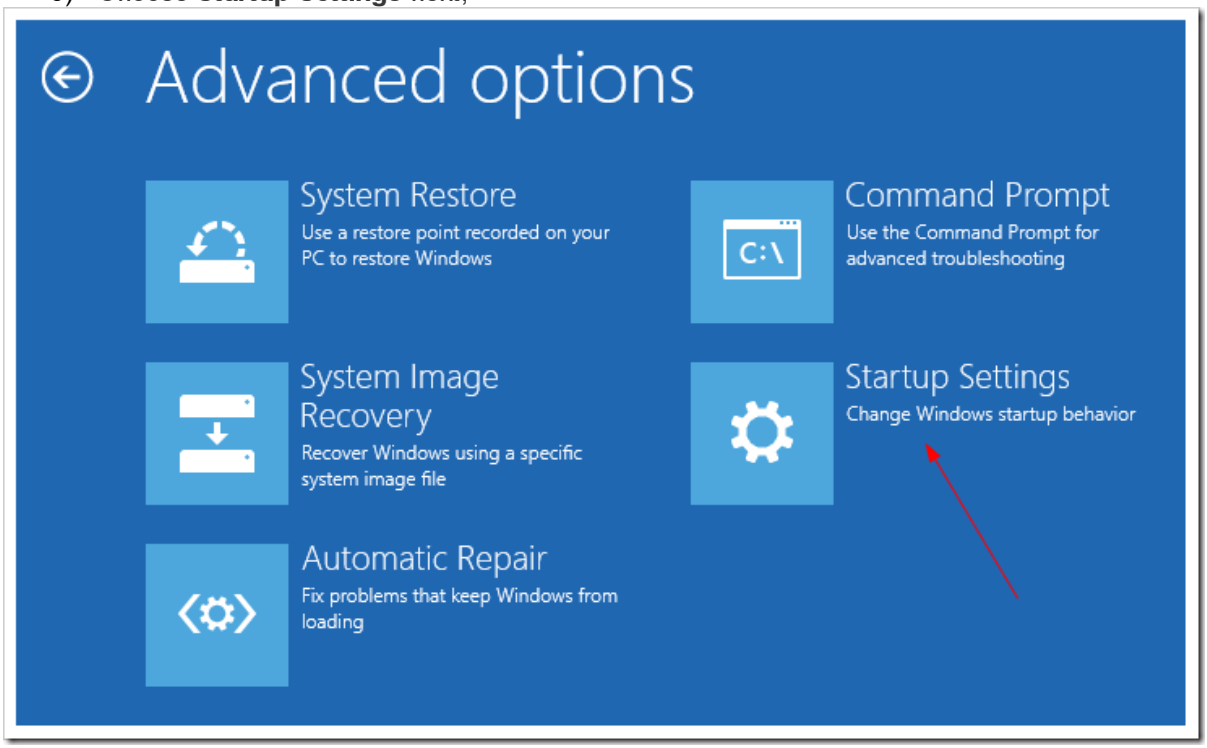
3) The computer reboots to a startup menu, in which click **Troubleshoot**.


Choose an option
Continue
Exit and continue to Windows 8
Troubleshoot
Refresh or reset your PC, or use advanced tools
Turn off your PC

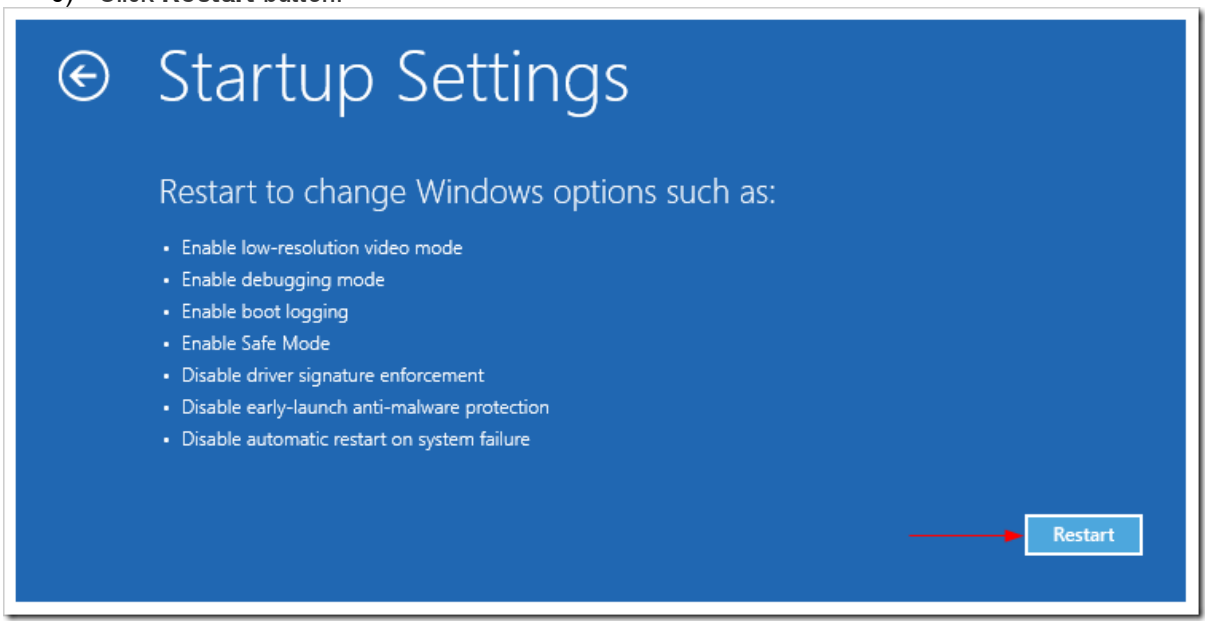
4) Click **Advanced Options** at next screen.


Troubleshoot
Refresh your PC
If your PC isn't running well, you can refresh it without losing your files
Reset your PC
If you want to remove all of your files, you can reset your PC completely
Advanced options

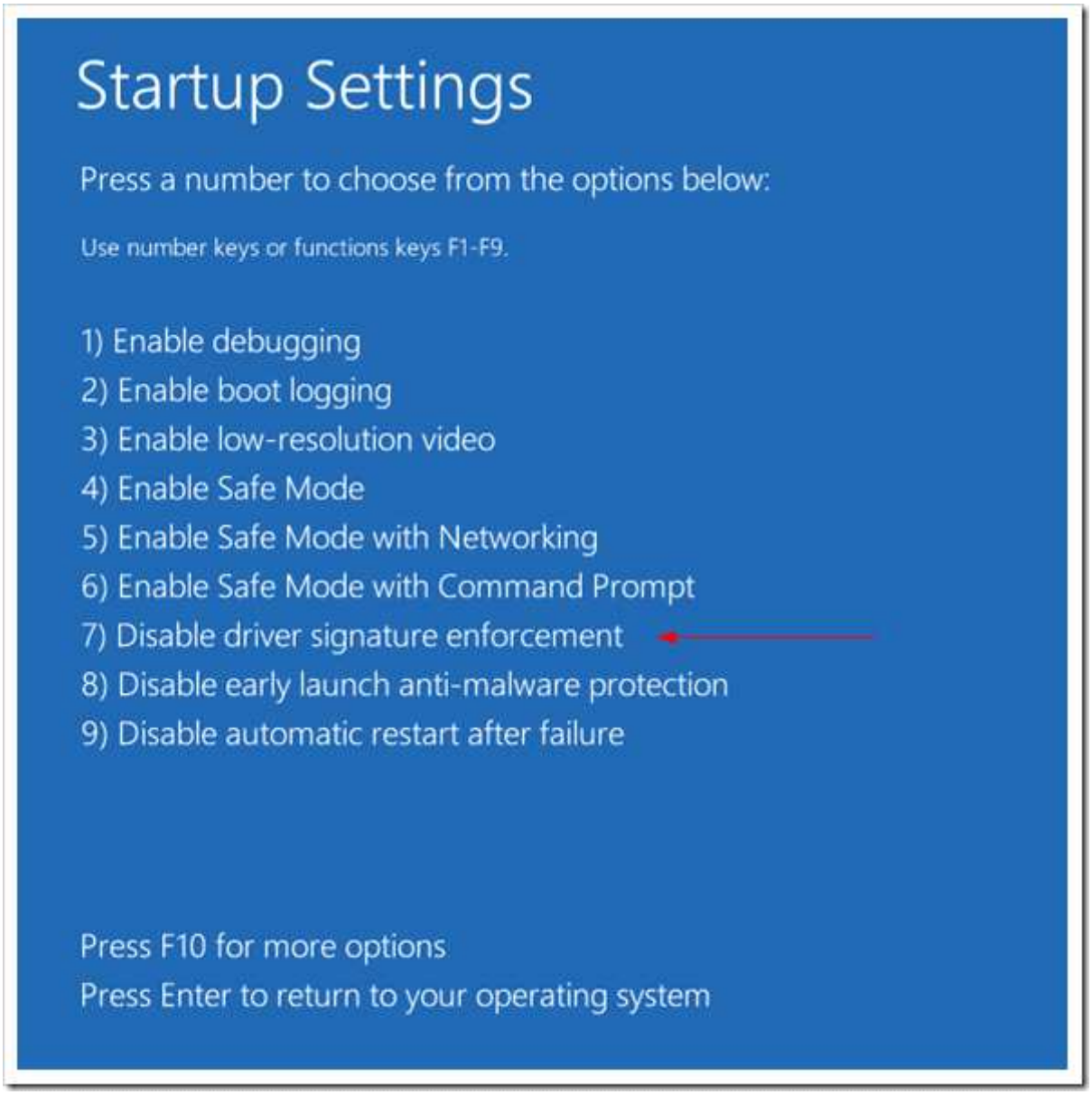
5) Choose **Startup Settings** next,


Advanced options
System Restore
Use a restore point recorded on your PC to restore Windows
Command Prompt
Use the Command Prompt for advanced troubleshooting
System Image Recovery
Recover Windows using a specific system image file
Startup Settings
Change Windows startup behavior
Automatic Repair
Fix problems that keep Windows from loading

6) Click **Restart** button.



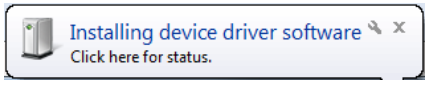
7) The computer reboots and prompts another menu to choose. One of the items is to '**Disable driver signature enforcement**'. Press number **7** or **F7** to continue booting to Windows 8 with digital sign enforcement disabled.


Startup Settings
Press a number to choose from the options below:
Use number keys or functions keys F1-F9.
1) Enable debugging
2) Enable boot logging
3) Enable low-resolution video
4) Enable Safe Mode
5) Enable Safe Mode with Networking
6) Enable Safe Mode with Command Prompt
7) Disable driver signature enforcement
8) Disable early launch anti-malware protection
9) Disable automatic restart after failure
Press F10 for more options
Press Enter to return to your operating system

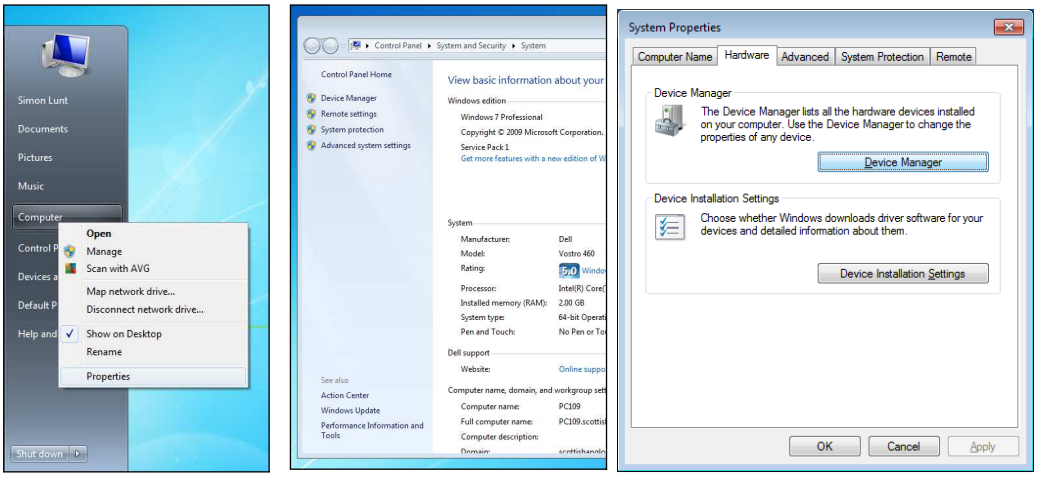
6.1.4.3 Installing the disc image

1) If installing from the ACG+ software CD, insert the disc into the CD drive.
2) Connect the ACG+ to the computer using the USB cable (see section 6.2) and switch on the ACG+.

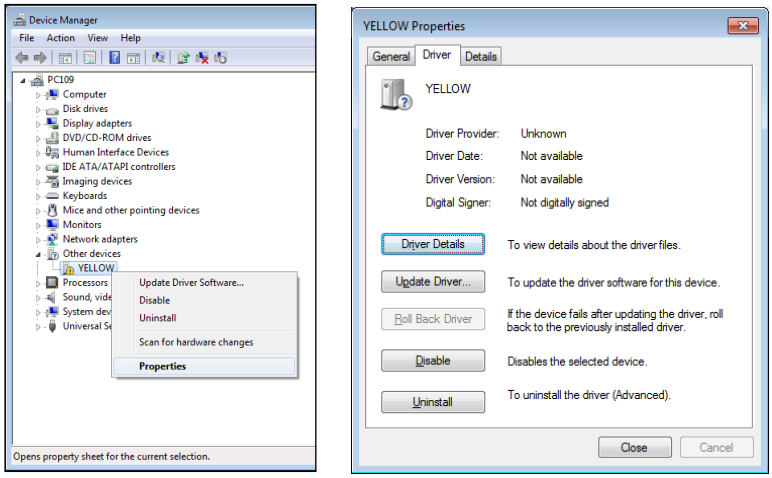
3) Windows will pop up a message box stating that it is attempting to install drivers. Windows will fail to find drivers for the device.



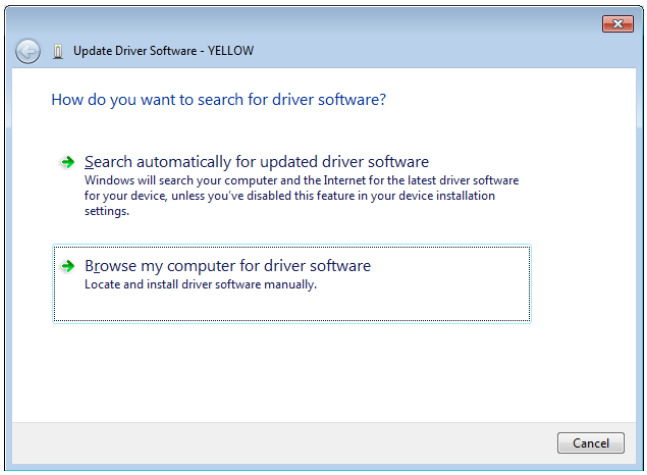
4) Access the system properties window by clicking on the Windows start menu, right-clicking on 'Computer' and selecting properties.
5) On the system properties window, click 'Advanced system settings'.
6) Select the 'Hardware' tab and click 'Device Manager'.



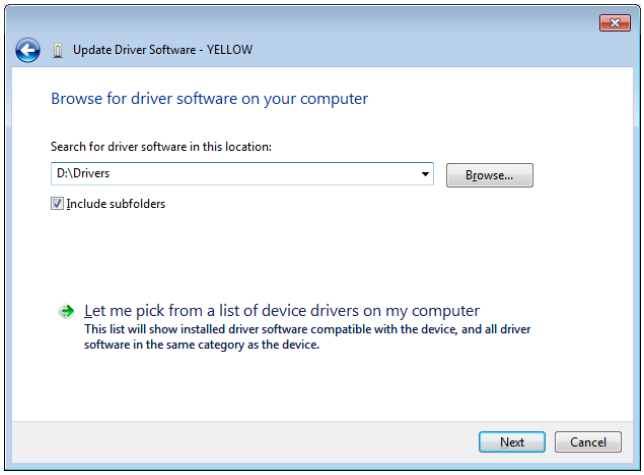
7) In the device manager window, locate 'YELLOW' under 'Other devices'. Right click this and select 'Properties'.
8) Select the 'Driver' tab and click 'Update Driver...'.



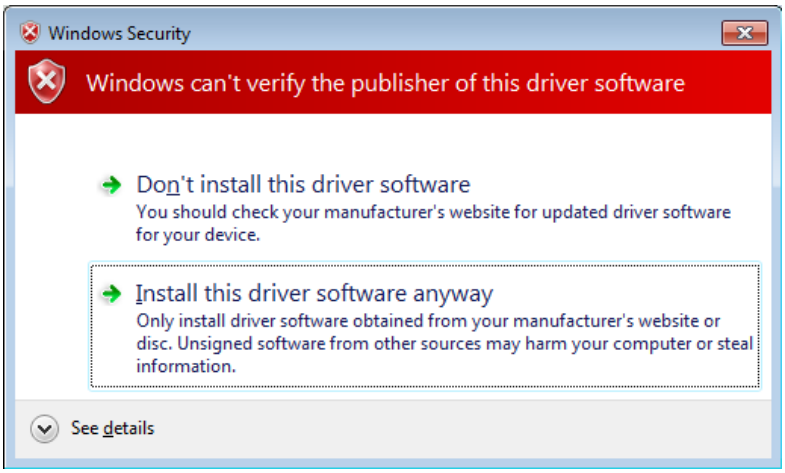
9) Click 'Browse my computer for driver software'.


Update Driver Software - YELLOW
How do you want to search for driver software?
Search automatically for updated driver software
Windows will search your computer and the Internet for the latest driver software for your device, unless you've disabled this feature in your device installation settings.
Browse my computer for driver software
Locate and install driver software manually.
Cancel

10) Click 'Browse' and locate the ACG+ driver folder. This will be the folder named 'Drivers' on the ACG+ software disc. Click 'Next'.


Update Driver Software - YELLOW
Browse for driver software on your computer
Search for driver software in this location:
D:\Drivers
Browse...
Include subfolders
Let me pick from a list of device drivers on my computer
This list will show installed driver software compatible with the device, and all driver software in the same category as the device.
Next
Cancel

11) Click 'Install this driver software anyway' when prompted.


Windows Security
Windows can't verify the publisher of this driver software
Don't install this driver software
You should check your manufacturer's website for updated driver software for your device.
Install this driver software anyway
Only install driver software obtained from your manufacturer's website or disc. Unsigned software from other sources may harm your computer or steal information.
See details

12) The ACG driver will then install.
13) After installation reverse the process of disabling driver signature enforcement by completing section 6.1.4.2 and choosing '**enable driver signature enforcement**' on the last step, press number **7** or **F7** to continue booting to Windows 8 with digital sign enforcement enabled..
14) When complete, the Windows Mobile Device Centre main window may pop up. This window can be closed. Accept the Windows Mobile Device Centre user agreement if prompted.
15) From the ACG software disk, run the installer file called 'Setup'.
16) The ACG installer wizard will be displayed. Follow the on-screen instructions to install the ACG software.

6.1.5 Installation troubleshooting

If the ACG drivers fail to install, please try the following:

- Disconnect any USB devices from the computer that are not required.
- Ensure that ActiveSync® or Windows® Mobile Device Centre are installed before attempting to install drivers.
- Sometimes users can experience problems connecting a device on Windows® XP. When this happens, ActiveSync® does not recognise a connection to the device. To correct this, select 'Add or Remove Programs' from the Windows control panel. Choose to remove Microsoft ActiveSync®. After this is removed, browse to C:\Program Files and delete the ActiveSync folder. Restart the computer and reinstall ActiveSync® using the installer.

6.1.6 Running the software

To run the ACG+ software, select the program from the Windows® start menu, Analox folder. When the software runs without a device connected, the window shown in Figure 41 will be displayed.

Figure 41 - ACG+ software without device connected

6.2 Making a connection

Note: The ACG+ software uses Microsoft ActiveSync® to communicate with an ACG+. Before connecting to an ACG+, ensure that any other windows mobile devices or devices which make use of ActiveSync® are disconnected from the computer.

Always connect only one ACG+ to the computer at a time. To connect an ACG+ to the computer, first open the hinged front door of the ACG+ device by loosening the four corner screws. Locate the ACG+ display module which is mounted to the inside of the ACG+ hinged front door. Connect one end of the USB cable provided to the right hand USB port (labelled 'PC') on the rear panel and connect the other end of the cable to a free USB port on the computer. Power the ACG+ device and allow it to start up.

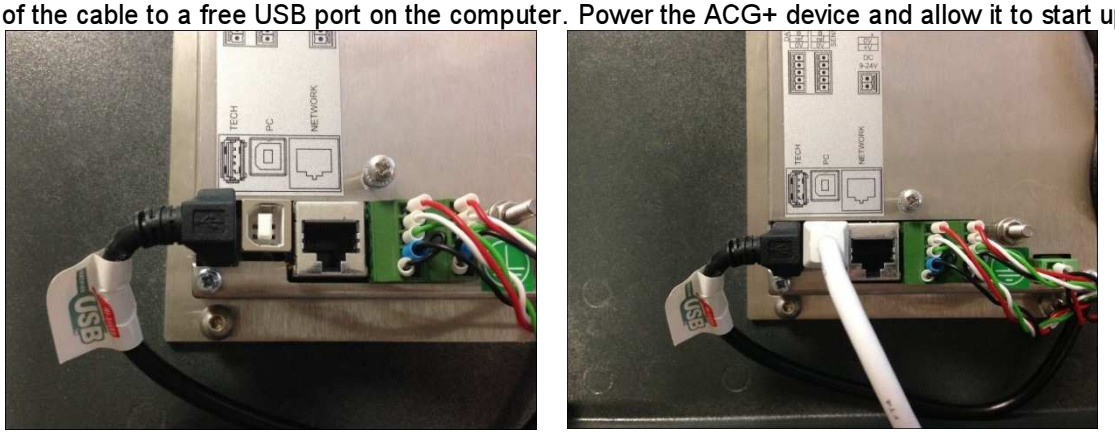


Figure 42 - Connecting a USB cable to an ACG+

Once connected and powered, Windows® should detect the device and display an information bubble confirming the connection. On the first time connecting an ACG+ to the computer, message bubbles may be shown explaining that device drivers are being installed. This should take a few moments.

When the device connects, on Windows XP® systems, the ActiveSync® window will pop up. This window should be closed. On Windows 7® systems, the Windows Mobile Device Center window will be shown. This window should be closed.

If not already open, run the ACG+ software. The ACG+ software will recognise the device and read the current settings form the device. Once fully connected the window shown in Figure 43 will be displayed.

6.2.1 Connection troubleshooting

If the ACG+ fails to connect, see section 7.1.4 Connection troubleshooting

6.2.2 Disconnecting

To disconnect an ACG+ from the computer, first wait until all settings have been saved correctly and that any file downloads have completed then remove the USB cable from the rear of the ACG+. If the USB cable was removed from the 'Tech' USB port, ensure that it is re-attached before closing and securing the ACG+ hinged front door.

6.3 Changing options

On connection to an ACG+, a copy of all of the device's options is created in the ACG+ software. The options are presented over a set of tabs. To view the option tabs, click the 'Options' button. Using these tabs the options can be viewed and modified as required. No changes are made to the device's options until the changes are applied to the device. To apply any changes made click the 'Apply Changes' button (shown in Figure 43). This will upload the new options to the device. The ACG+ will confirm that the options have been saved by playing a confirmation sound.

Any changes made to options can be discarded as long as they have not yet been applied to the device. To re-download the current device settings from an ACG+, click the 'Read Options' button (shown in Figure 43).

Figure 43 - ACG software with device connected showing general options

6.3.1 General options

The general device options are displayed by clicking on the 'General' tab. Figure 43 shows the general options.

6.3.2 Device information

This shows the serial number and the software version of the connected device.

6.3.3 Latching alarms

The latching alarms checkbox enables or disables latching alarms as described in section 5.9.3.

6.3.4 Date and time

The 'Set Time...' button can be used to set the date and time on the device as described in section 6.5
Note: Any changes made to the general options will not come into effect on an ACG+ device until the 'Apply Changes' button has been clicked with the exception of setting the date and time (see section 6.5).

6.4 Downloading data-logs

The data stored on an ACG+ can be downloaded using the ACG software. To view the data-log management controls, click the 'Logs' button (Figure 44). A list of the data-log files available on the device will be shown. The data-log files are stored by date. Each date's file contains all of the data logged whilst the device was running during a particular day. This list can be refreshed by pressing the 'Refresh' button.

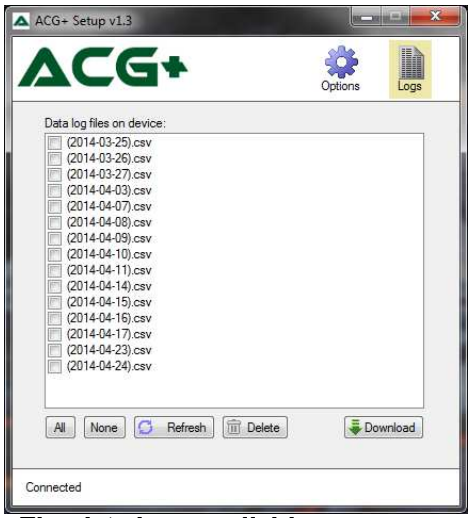


Figure 44 -The data logs available on a connected ACG+

Data-log files can be downloaded individually or in batches. To select the files that are to be downloaded, click on the checkbox next to each of the files of interest. The 'All' and 'None' buttons can be used to select or deselect all of the files respectively. Once a selection has been made, the log file download can be started by clicking the 'Download' button. Figure 45 shows a selection of files being downloaded.

Note: The time taken to download data logs will vary depending on the number of log files selected and the amount of log data inside each file. This process may take several minutes. It's should also be noted that downloading a full data log may download up to 150MB of log data. Please ensure that there is enough storage space on the target disk before beginning a download.

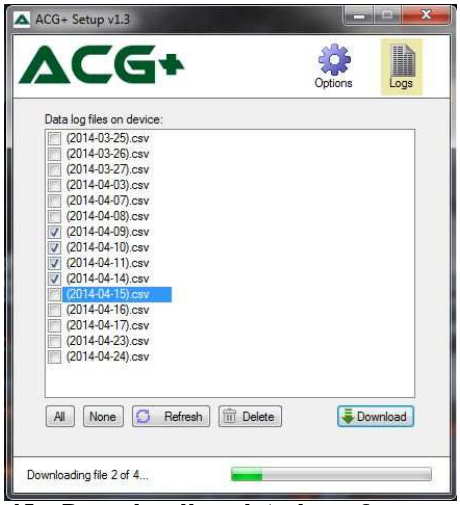


Figure 45 - Downloading data logs from an ACG+

Although the internal data-logging operates a rolling log with automatic clean-up of older data, the data-logs on the device can be managed manually using the ACG software. To delete unwanted files from a device, select the files for deletion and click the 'Delete' button.

6.5 Setting the time

The ACG+'s internal date and time is used for data-logging and for issuing various reminders. The internal clock can be set to the appropriate date and time using the ACG+ software. With an ACG+ connected to the ACG software, select the 'General' tab. Click the 'Set Time...' button. This will display the window shown in Figure 46. The default time shown will be the system date and time of the computer running the software. This date and time can be changed if required. To set the date & time on the device click OK. The ACG+ will play a sound to acknowledge that the date and time have been set successfully.

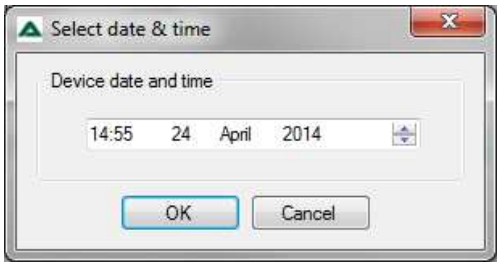


Figure 46 - Setting the date and time on an ACG+

7 Troubleshooting

7.1 System faults

An instrument constantly monitors itself for fault conditions. Any fault conditions that are identified will trigger a fault alarm. When a fault alarm is raised, the horn will sound immediately. Faults will be indicated on the display with the status bar coloured yellow as shown in Figure 47. Fault alarms can be muted in the same way as standard alarms by pressing the mute button.

All fault alarms are latching so if an intermittent fault is identified and subsequently cleared, the alarm will continue to be displayed and sounded until the mute button is pressed to acknowledge the fault.

Information about the fault condition identified is displayed alternating with the sensor reading if valid as shown in Figure 47 in which a sensor communication fault is shown. In cases where a fault prevents a valid reading from being obtained from a sensor then the reading will not be shown on the display and will instead be replaced by '---' interleaved with the fault code.

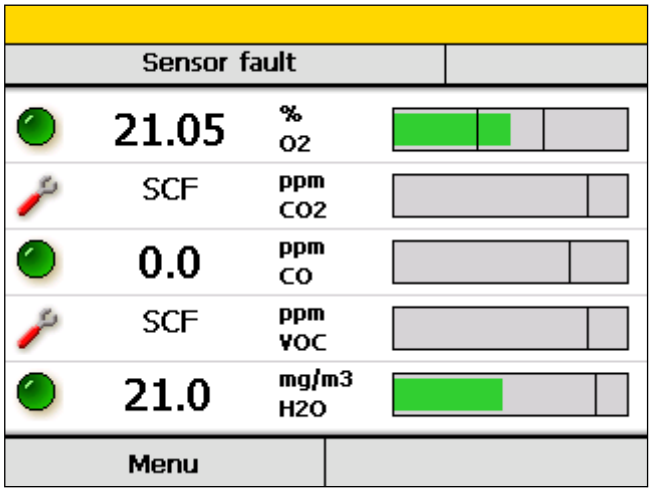


Figure 47 - A system showing a fault condition

7.1.1 System fault conditions

The following table explains the possible system fault conditions that may be displayed in the status bar:

Table 9 List of system faults and possible solutions

System status	Meaning	Possible solution
High flow	The flow rate through the system is too high.	Check that the pressure of the sample gas being applied to the ACG+ is within specified limits (section 10.1). High flow is usually a result of low inlet pressure.
Low flow	The flow rate through the system is too low.	Check that the pressure of the sample gas being applied to the ACG+ is within specified limits (section 10.1). Low flow is usually a result of high inlet pressure. Low flow may also indicate a leak or loose connection in the internal plumbing. Check for any obvious breaks in the internal plumbing.
Sensor alarm	One or more sensor(s) has identified that its measurement is outside of the specified alarm limits (section 5.9).	Check that the alarms specified for the sensor(s) are as intended. Check the source of gas for problems which may have caused the alarm condition.
Sensor fault	One or more sensor(s) has identified a fault in its operation.	See the sensor faults table (7.1.2) for further fault diagnostics.
System fault: ESF	The system cannot properly communicate with its environment sensor.	The environment sensor may have developed a fault. This is not a user serviceable fault. Please contact your supplier.
System fault: ICF	The system has lost communication with its chassis board.	Check that all connections between the display module and the chassis board are secure. Restart the ACG+ device to see if the fault clears. If the fault persists, contact your supplier for repair advice.

7.1.2 Sensor fault conditions

The following table explains the possible sensor specific fault conditions that may be displayed for each sensor:

Table 10 List of sensor faults and possible solutions

Sensor status	Meaning	Possible solution
CAL	The sensor has detected that its two calibration points are too close together to give a sensible reading.	Perform a full calibration of the sensor, ensuring that the high and low calibration gases are sufficiently different in value with respect to the specified sensor range (section 10.1). A correct calibration should clear this fault. If this fault persists, it may be necessary to replace the electrochemical cell if the sensor is of this type (section Error! Reference source not found.). Alternatively, exchange the sensor for a spare of the same type, if available and contact your supplier for repair advice.
ICF	The sensor has developed an internal communications fault.	The most likely source of this fault is the connection between the H2O sensor and the chassis board. Check that this connection is correctly made.
RNG or SRF	The sensor's reading is outside of acceptable range.	This problem can often be solved by a full calibration of the sensor. If this problem persists then it may be a symptom of a sensor failure. Exchange the sensor for a spare of the same type, if available and contact your supplier for repair advice.
SCF	The ACG+ has lost serial communications with the sensor.	Check that the wired connection between the sensor showing the fault and the chassis board is made correctly.
CRC, FTL, LMP, PID, PWR, TMP or UKN	A sensor failure condition has been observed.	Restart the ACG+ device to see if the fault clears. If the fault persists, exchange the sensor for a spare of the same type, if available and contact your supplier for repair advice.

7.1.3 Calibration adjustment failures

When making a calibration adjustment for a sensor (section 5.10.2) the calibration request can sometimes be rejected by the sensor. There are several reasons why an adjustment can be rejected. These are as follows:

An inappropriate concentration of gas has been applied for the calibration point. For example, a full scale gas has been applied when attempting to perform a low calibration adjustment.
The concentration of gas specified by the user does not match the concentration of the calibration gas.
The amount by which the calibration value differs from the current sensor reading is too great.
The electrochemical cell (oxygen or carbon monoxide) has depleted over time. Its output may have dropped too far to perform an adequate adjustment. This can be an indicator that the cell should be replaced, even if the cell replacement warning is not yet shown.
The PID detector (VOC sensor) may have become overly dirty due to exposure to oil or other contaminants.

To remedy a calibration failure the following corrective measures can be attempted.

Check that the gas value being entered for the adjustment corresponds to the concentration given on the calibration bottle.
Check that an appropriate gas concentration is being applied for the type of calibration (low calibration close to minimum sensor range and high calibration close to maximum sensor range).

Check that there is no flow warning currently being shown. See Table 9 for information about flow faults.
Check that there are no other sensor faults currently shown.
For O2 or CO sensor, replace the sensor's electrochemical cell (section 9.1).
For VOC sensor, clean or replace the PID lamp component (section 9.1).
If the problem persists, please contact your supplier for assistance.

Diagnostic logging

In instance of system faults, it may be necessary to provide more diagnostics information to a service engineer. All instances of fault conditions that are identified will be logged to the instrument's diagnostics log. The diagnostics log can be downloaded using the ACG+ software. To download the log, connect to the device as described in section 6.4. Access the 'Advanced' tab and click 'Download diagnostics log...'. This will give the option to specify a save location for the log file.

7.1.4 Connection troubleshooting

If the ACG+ fails to connect, please try the following:

1. Disconnect the ACG+ from the computer
2. Go to the folder **C:\Program Files\Microsoft ActiveSync\Drivers** and look for the file called **wceusbsh.sys**
3. Select this file, copy it and paste it into the following folder **C:\Windows\System32\drivers**
4. Restart the computer
5. When restarted, connect the powered up ACG+ to the computer
6. Follow the user manual instructions for installation of the device drivers. This time the installer should locate the correct file and install correctly

8 Recommended spares and accessories

Table 11 List of spares

Item	Description	Part no.
1	VOC in-line filter (6mm inlet/outlet)	6000-0096
2	Internal particulate filter	2533-1008
3	MEC O2 full sensor module	MECO2ABAP
4	MEC O2 cell (electrochemical)	9100-9212-9HM
5	MEC CO full sensor module	MECCOEBAP
6	MEC CO cell (electrochemical)	9100-2030
7	MEC VOC full sensor module	MECVOCBAP
8	MEC VOC cell (PID)	9100-2060
Replacement VOC sensor parts		
9	Disposable electrode stack	9100-2060/ES
10	10.6 eV replacement lamp	9100-2060/LP
11	Replacement spring	9100-2060/SP
Service parts		
12	5S3 CO2 full sensor module	A5S3ASN8A
13	ACG+ Display Module – Configured for CO2, O2, CO, VOC and water vapour	ACGSDA/1
14	ACG+ Display Module – Configured for CO2, O2, CO and VOC	ACGSDA/2
15	ACG+ Display Module – Configured for CO2, O2, CO and water vapour	ACGSDA/3
16	ACG+ Display Module – Configured for CO2, O2, CO	ACGSDA/4
17	Replacement oring for sensor flow adaptor	2323-0017X

Table 12 List of accessories

Item	Description	Part no.
1	External PSU, 24VDC, 2.7A, 65W for connection to front panel via panel mount connector (For use with Portable & Fixed variants)	ACGPEXTPSU
2	External PSU, 24VDC, 2.7A, 65W for connection through gland direct onto interface PCB (For use with fixed variants)	ACGEXTPSU
3	Li-Ion rechargeable battery pack kit (Includes charger and battery casing – for portable variants)	P0149-605L
4	Spare Li-Ion rechargeable battery pack (Includes battery casing lid – for portable variants)	P0149-605LS
5	NiMH rechargeable battery pack kit (Includes charger and battery casing – for portable variants)	P0149-605N
6	Spare NiMH rechargeable battery pack (Includes battery casing lid – for portable variants)	P0149-605NS
7	Inlet/Calibration adaptor	6000-0201
8	0.5LPM 110L bottle regulator	SA7L705XFLIND
9	Zero calibration gas (8% oxygen, balance nitrogen)	SA7L110174
10	Nitrogen background span calibration gas, (18ppm carbon monoxide, 18ppm isobutylene, 20.9% oxygen, 900ppm carbon dioxide, balance nitrogen)	SA7L110173
11	Helium background span calibration gas, (18ppm carbon monoxide, 18ppm isobutylene, 20.9% oxygen, 900ppm carbon dioxide, balance helium)	SA7L110180
12	Pressure regulator, 2 stage, 300bar gauge to 0 to 10 bar gauge, ¼" NPT female inlet & outlet	6000-0123
13	Combined beacon/sounder, 24V DC, IP65 (For fixed variant)	2562-0008
14	30mm open ended spanner	9300-1020
15	Gastec Airtec Tube (Oil Mist) 109A, Pk10	9100-3500
16	Rubber Tube Holder for colourmetric tubes	GAS357
17	Drager Oil Impactor, Pk10	9100-3501
18	Override Keyswitch & Gland Kit	P0149-610
19	Humidifier Kit	P0149-660
20	External flow meter sample support kit	P0149-611
21	VOC electrode stack removal tool	9300-1021
22	VOC lamp cleaning kit	9300-1022
23	ACG+ Fixing Kit	P0075-615

9 Maintenance requirements

Certain elements of the ACG+ system require regular, preventative maintenance to ensure optimum operation. Table 13 shows the maintenance that is required and the scheduled interval for performing the maintenance.

Table 13 Maintenance schedule of ACG+ components

System component	Maintenance required	Maintenance interval
Oxygen sensor	Replace electrochemical cell	Approx. 2 years or as required.
Carbon monoxide sensor	Replace electrochemical cell	Approx. 2 years or as required.
VOC sensor	Clean PID lamp and electrode stack	As required, recommended every 3 months.
	Replace PID lamp or whole PID cell	Lamp - 5,000 hours (~6 months) Cell – 5 years or as required.
Carbon dioxide sensor	Replace sensor	6 years
Water vapour sensor	Factory calibration exchange	2 years
Activated charcoal filter	Replace filter	1 year
PID particulate filter	Replace filter	6 months or as required (Depending on how dirty sample is)

9.1 Sensor & filter replacement

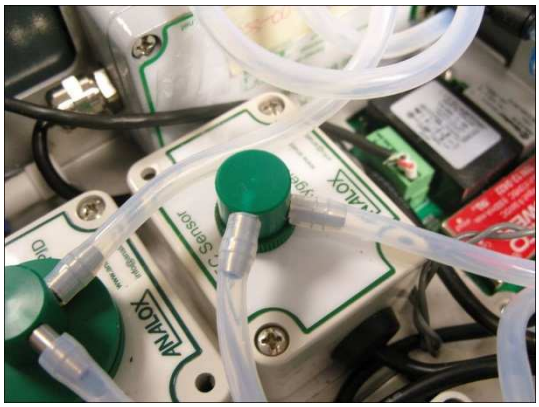
Before attempting to replace any filters or sensors ensure that the ACG+ is switched off and the gas supply has been isolated and disconnected. Using a Pozi-drive screwdriver loosen the 4 enclosure lid screws and open the lid.

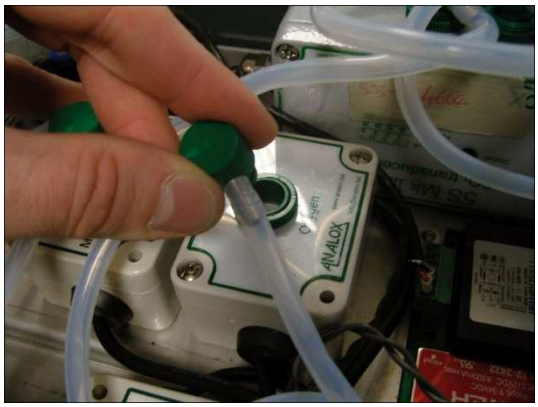
9.1.1 Oxygen cell replacement

The part number for your sensor's replacement cell is: **9100-9212-9HM**

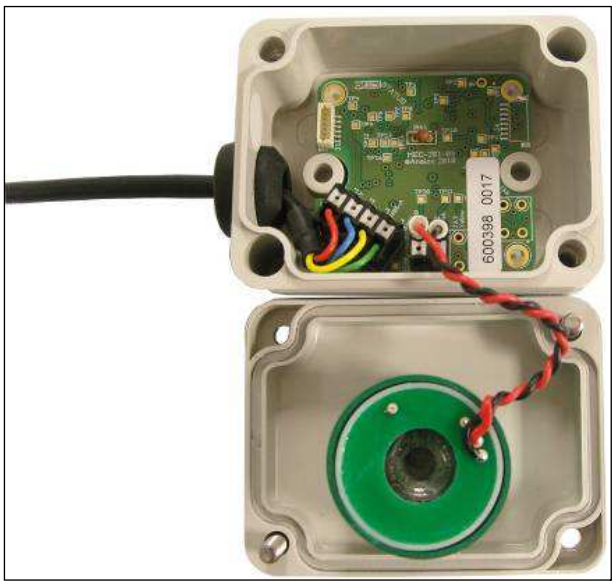
When a replacement cell is received check that the cell has not leaked. The cells are themselves sealed and do not under normal circumstances present a health hazard however if leakage of the electrolyte has occurred use rubber gloves and wear chemical splash goggles to handle and clean up. Rinse contaminated surfaces with water. If contact is made with the electrolyte, please refer to Section 1.

Remove the flow adaptor from the sensor inlet.

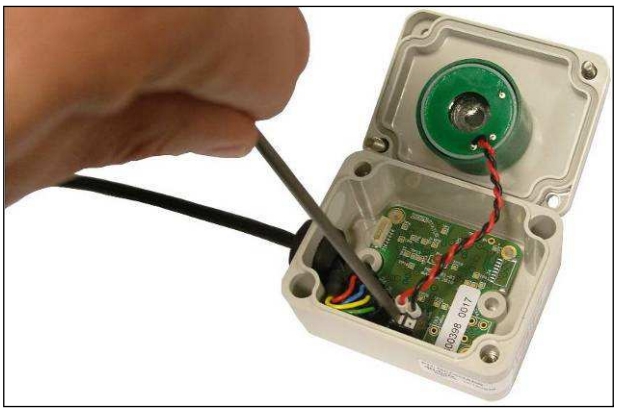




Loosen the corner screws of the enclosure and remove the lid.



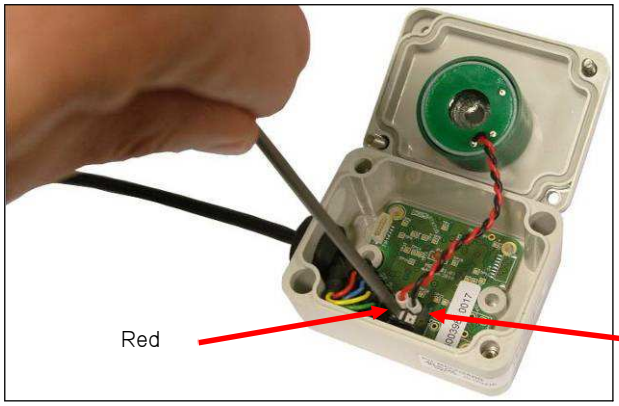
Using a terminal screwdriver push down the clamp release button to release the clamp and gently pull the cell wire from the clamp. Repeat this for both the red and black wires.



Unscrew the green locking ring from the chimney of the cell housing and remove from the enclosure lid.

Fit the new cell in to the enclosure lid and secure in place using the locking ring.

Using a terminal screwdriver, push down the clamp release button to release the clamp. Push the ferrule of the cell wire in to the clamp and remove the screwdriver from the clamp release button. Gently pull on the wire to ensure that the wire is held by the clamp. Repeat this for both the red and black wires, taking note of the correct polarity as shown below.



Refit the enclosure lid in place and secure in place using the corner screws.

Refit the flow adaptor in to the sensor inlet

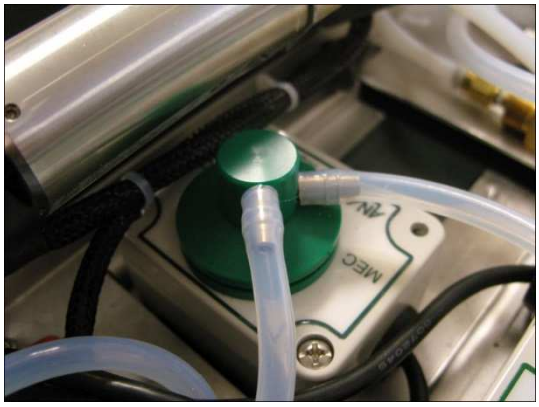
Note: Following an oxygen cell replacement a full calibration must be performed. See section 5.10 for details. Also, a replacement notification reset should be performed. See section 5.14.1 for details.

9.1.2 Carbon monoxide cell replacement

The part number for your sensor's replacement cell is: **9100-2030**

When a replacement cell is received check that the cell has not leaked. The cells are themselves sealed and do not under normal circumstances present a health hazard however if leakage of the electrolyte has occurred use rubber gloves and wear chemical splash goggles to handle and clean up. Rinse contaminated surfaces with water. If contact is made with the electrolyte, please refer to Section 1.

Remove the flow adaptor from the sensor inlet.



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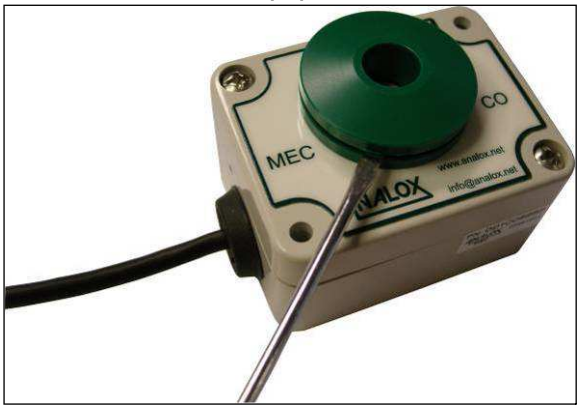
Use a flat blade screwdriver to pop out the cell holder from the sensor bulkhead fitting.



Rotate the cell PCB connector clockwise to release from the cell holder.

Disconnect the cell from the PCB connector.

Connect the new cell to the PCB connector (Note that it will only connect in one orientation).

Fit the cell in to the housing and rotate anti-clockwise to lock in place.

Refit the cell holder in to the sensor bulkhead.

Refit the flow adaptor in to the sensor inlet.

Note: Following a carbon monoxide cell replacement a full calibration must be performed. See section 5.10 for details. Also, a replacement notification reset should be performed. See section 5.14.1 for details.

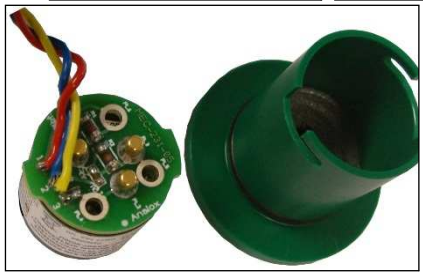
9.1.3 VOC maintenance

Maintenance of the VOC sensor can be done by the following methods, clean or replace the lamp, or replace the electrode stack. Cleaning the lamp should be performed as required, if the sensitivity of the sensor reduces over time. Replacement of the PID lamp should be performed after 5000 hours of use. Replacement of the electrode stack should be performed only if the sensor has been damaged by contamination.

The lamp and electrode stack are both part of the PID component of the sensor. The cleaning an replacement processes are documented below.

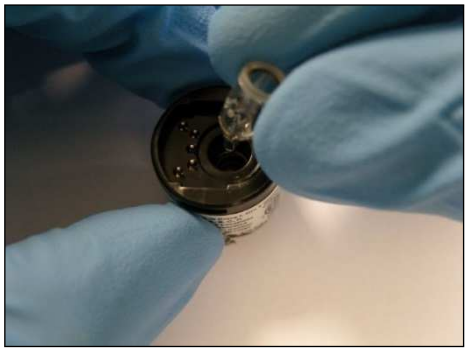
Remove the flow adaptor from the sensor inlet.

Remove the sensor housing from the MEC and then remove the sensor from the housing by twisting the PCB on the rear of the sensor, remove the PCB from the sensor



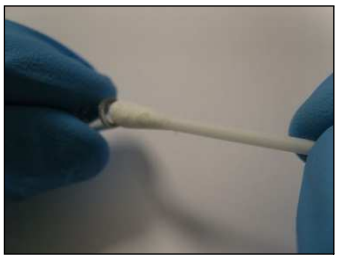
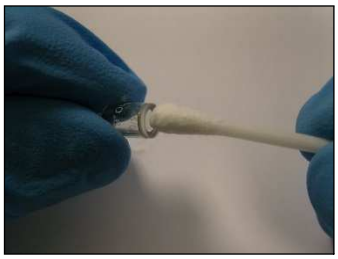
Using the stack removal tool (9300-1021) insert the ends of the tool into the slots on the sides of the sensor as shown, keeping a finger on top of the stack so as it does not spring away from the sensor and so that the spring and lamp cannot pop out upon removal.

Carefully remove the lamp from the sensor, making sure that the window of the lamp is not touched.



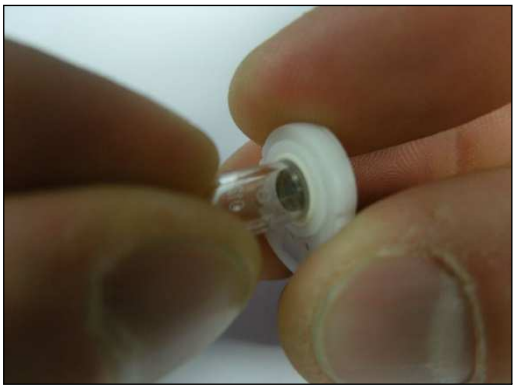
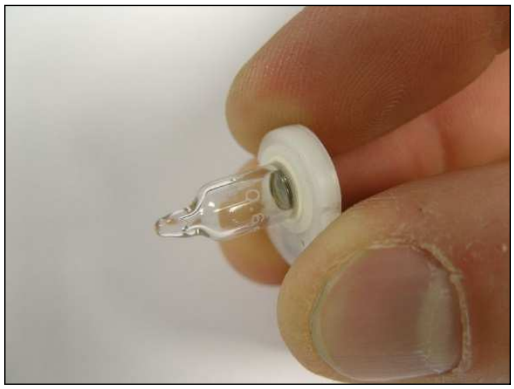
Using the lamp cleaning kit (9300-1022) and suitable protective clothing, open the container of cleaning compound, with a clean cotton bud, apply a small amount to one end.

Using a circular action, clean the lamp by applying light pressure to the lamp window (do not touch the lamp window with fingers), continue polishing until a light squeaking can be heard.

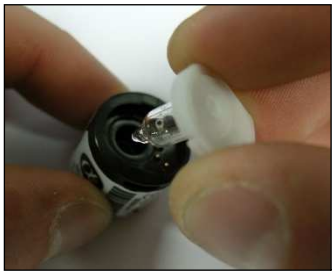
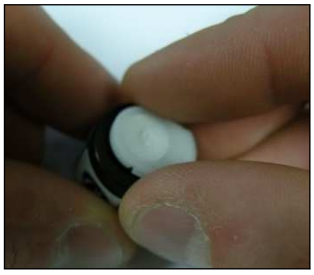



Remove any residual cleaning compound from the lamp using the clean end of the cotton bud. Ensure that the lamp is completely free from any signs of contamination prior to refitting.

Carefully place the lamp into the rear recess of the electrode stack, this will be held by the O-ring seal in the electrode pellet.

Take the electrode stack and the mated lamp and insert back into the sensor housing, push home until the electrode stack snaps into place, the top of the electrode stack should be flush with the top of the sensor housing.

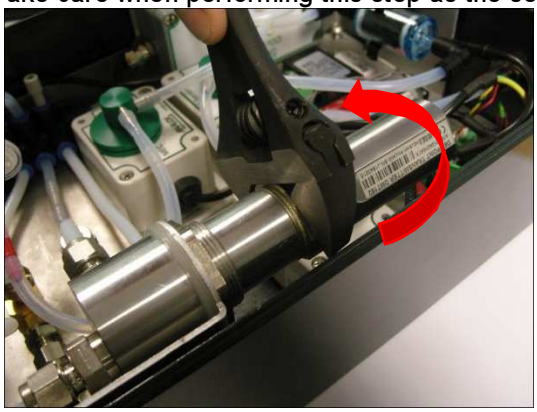



Note: Following a VOC PID lamp replacement or cleaning, or replacing the electrode stack a full calibration must be performed. See section 5.10 for details.

9.1.4 Water vapour sensor replacement

Disconnect the cable from the end of the water vapour sensor.

Using a 30mm spanner (part number 9300-1020), loosen the sensor from its housing and unscrew the sensor fully from its mount. Take care when performing this step as the sensor head is delicate.



Unscrew the protective cap from the new sensor and place it over the sensing head of the removed sensor.

Ensure that the dowty washer is fitted to the new sensor as shown and insert the new sensor into the sensor housing, taking care not to damage the sensor head. Screw the sensor in to its mount and fully tighten using a 30mm spanner

Re-connect the cable to the new sensor, into the port labelled 'II', checking for correct orientation. Push the connector in full to ensure it is secure.

Return the old sensor to your supplier for maintenance, ensuring that the sensor head is securely covered by the protective cap.

9.2 Filter replacement

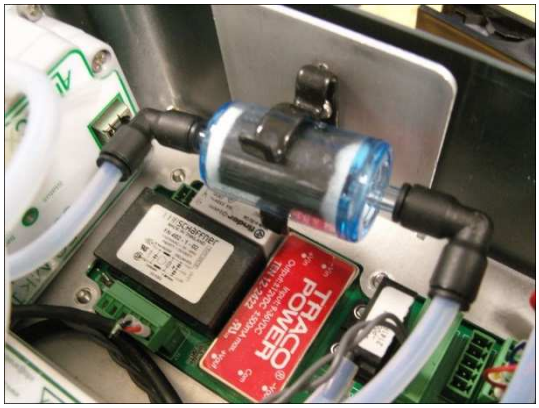
The ACG+ has two types of user changeable filters. These are the internal activated charcoal filter and an internal hydrophilic particulate filter.

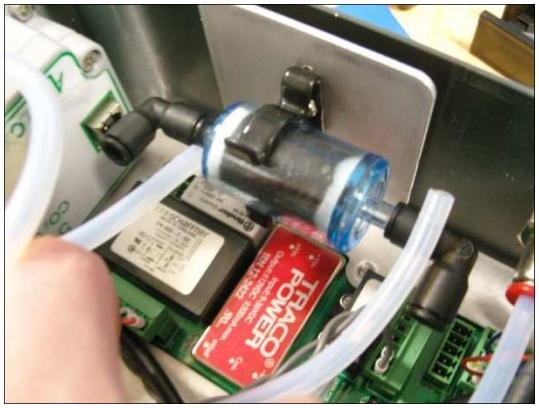
9.2.1 Activated charcoal filter replacement

The activated charcoal filter is fitted to absorb any VOCs present in the gas sample before the carbon monoxide content in the gas is measured by the carbon monoxide sensor. The carbon monoxide sensor is cross-sensitive to VOCs so this must be filtered out before gas sample is passed over the carbon monoxide sensor to ensure accurate measurement is made.

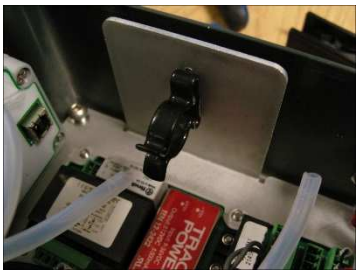
The procedure for changing the activated charcoal filter is as follows.

Disconnect both 6mm elbow push fittings from filter.





Remove filter from clip and remove the elbows from the filter.



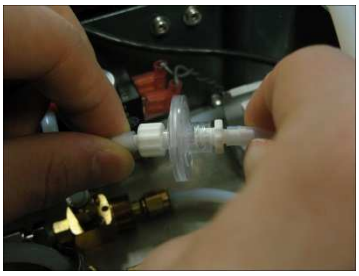
Reverse the above process to fit a new filter.

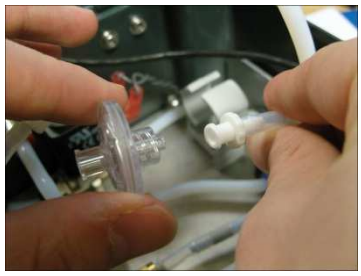
9.2.2 Particulate filter replacement

The particulate filter is used to remove larger particles of VOC's as they can after time block the inlet to the PID sensor, thus making the sensor read erratically or not read at all.

The procedure for changing the particulate filter is as follows:

Unscrew the filter from both of the male and female luers attached to the 6mm pipework from the inlet manifold.





Reverse the above process to fit a new filter.

9.3 Service requirements

Certain elements of the ACG+ system are recommended to be replaced every six years to ensure optimum operation. **Error! Reference source not found.** Below shows the maintenance that is required and the scheduled interval for performing the maintenance.

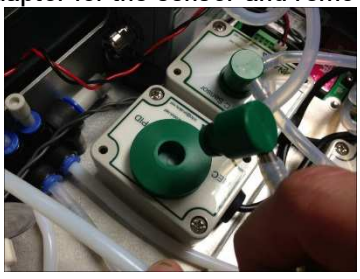
Table 14 Service schedule of ACG+ components

System component	Maintenance required	Maintenance interval
VOC sensor	Replace PID cell	5 years
Display module	Replace display	6 years
Carbon dioxide sensor	Replace sensor	6 years

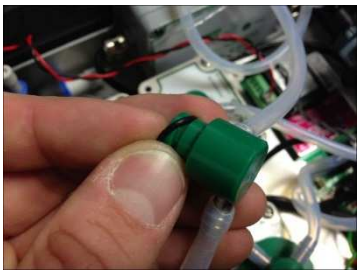
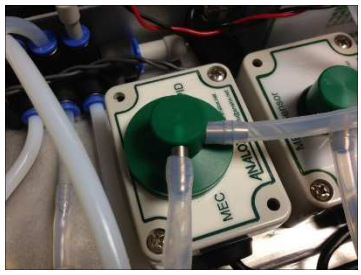
Before attempting to replace any sensors ensure that the ACG+ is switched off and the gas supply has been isolated. Using a Pozi-drive screwdriver loosen the 4 enclosure lid screws and open the lid.

9.3.1 Replacing the flow adaptor o-rings

Remove the flow adaptor for the sensor and remove the old oring.



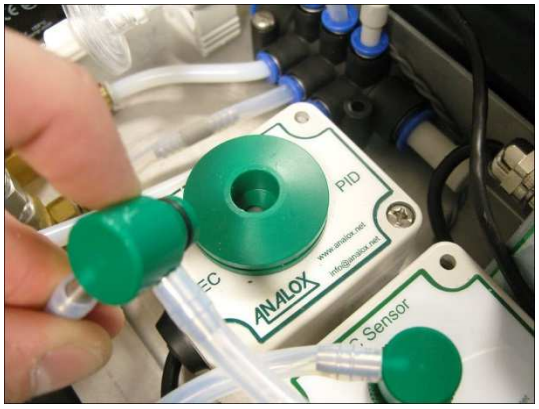
Take a new 11.1mmOD x 8.1mmID oring (2323-0017X) and refit to the flow adaptor, replace the flow adaptor to the sensor.

9.3.2 Replacing the PID cell

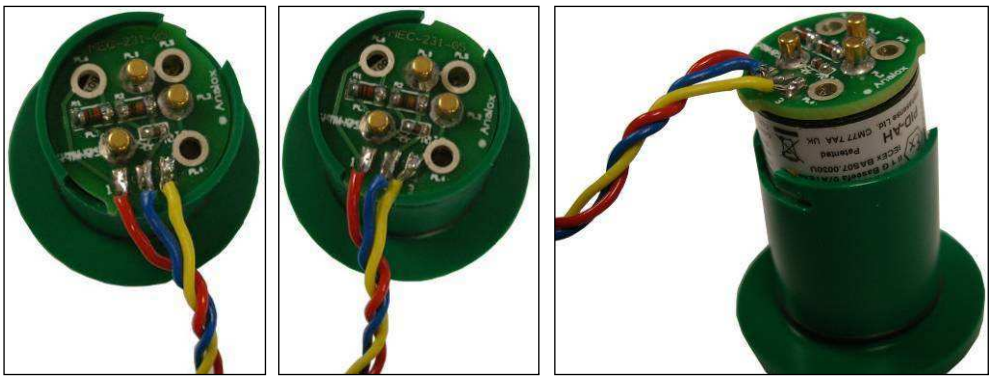
The following process describes how to replace the entire PID component if it is damaged or badly contaminated. The replacement part number for your sensor's PID is: **9100-2060.**

To replace the PID component, remove the flow adaptor from the sensor inlet.



Use a flat blade screwdriver to pop out the PID holder from the sensor bulkhead fitting.

Rotate the PID PCB connector clockwise to release from the PID holder.



Disconnect the PID from the PCB connector.

Connect the new PID to the PCB connector. Note that it will only connect in one orientation.

Fit the PID in to the housing and rotate anti-clockwise to lock in place.

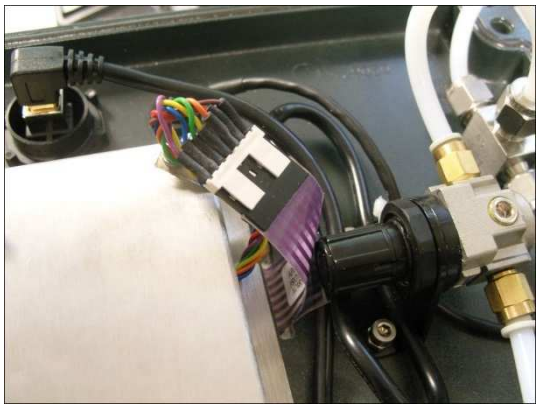
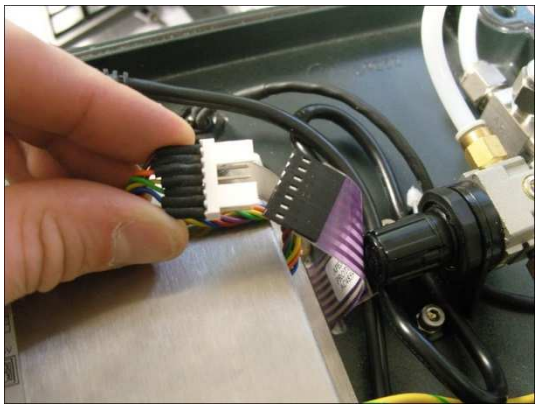
Refit the PID holder in to the sensor bulkhead.

Refit the flow adaptor in to the sensor inlet.

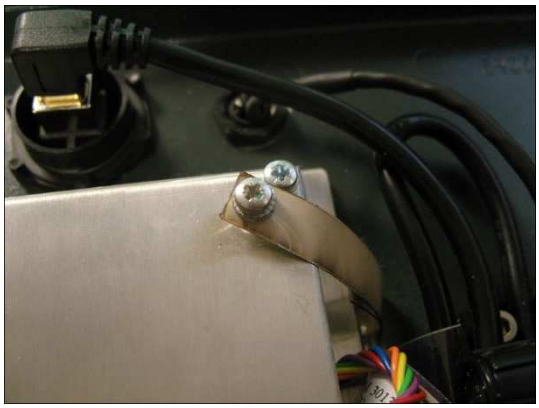
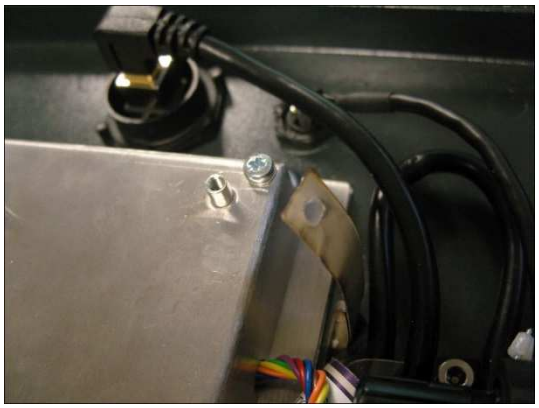
Note: Following a VOC PID lamp replacement or cleaning, or replacing the cell a full calibration must be performed. See section 5.10 for details.

9.3.3 Removing the display module

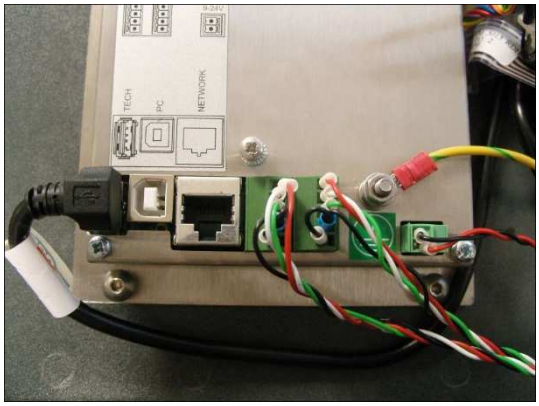
Disconnect the membrane label connection ribbon cable from the rear of the display module.

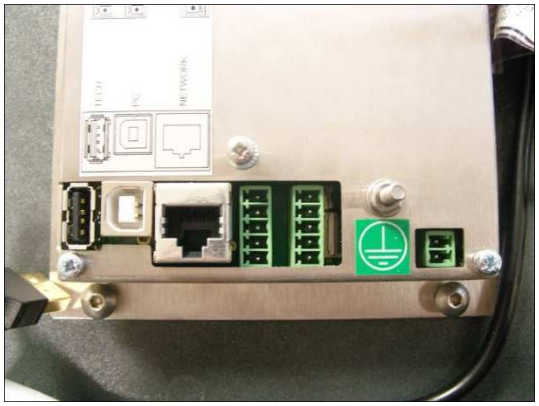



Disconnect the earth tag from the rear of the display module.

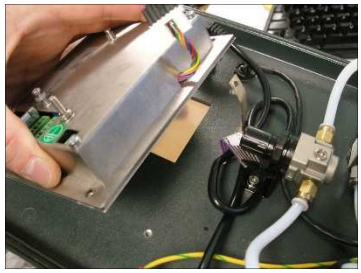



Remove all connections from the rear of the display module.





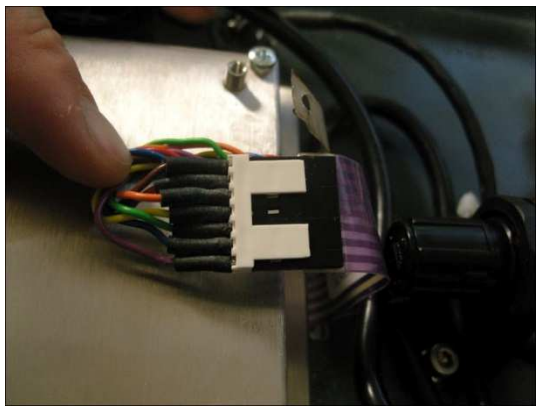
Using a 4mm hex key, remove the four M5 button head hex bolts from each corner on the rear of the display module, you should now be able to remove the display module.



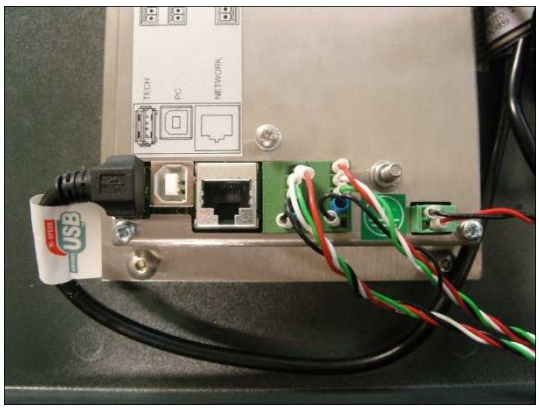
9.3.4 Installing a new display module

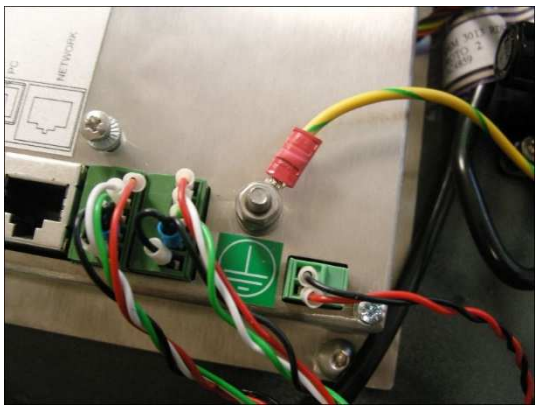
Take the new display module and align the front panel with the rear of the enclosure lid, mating up the holes in the panel with the four M5 threaded holes in the enclosure lid, secure in place with the previously removed M5 button head hex bolts using a 4mm hex key.

Feed the cable harness under the pipework for the flow meter, then reconnect the header to the ribbon header previously removed, making sure the brown wire is connected to the ribbon wire at the top of the ribbon.



Reconnect the display module cables and USB lead and then fit the earth lead to the stud on the rear and secure in place with a spring washer and nut supplied fitted to the earth stud.



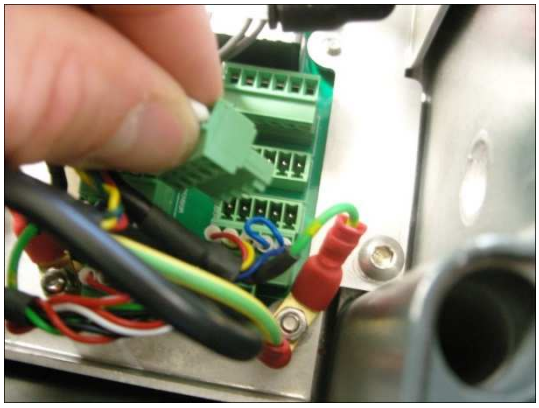


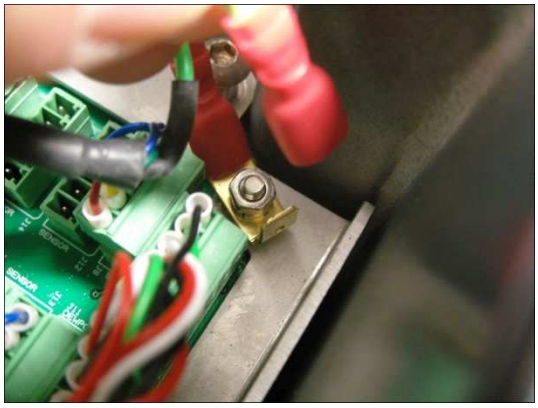
9.3.5 Removing the 5S3 CO_2 sensor

Remove the two flow adaptors from the top of the 5S3 sensor

Using a 4mm hex key, remove the two M4 hex bolts from the top right and bottom left corners of the 5S3 sensor.

Unplug the 5S3 sensor from the chassis PCB at location J12, then remove the earth wire from the earth tab on the chassis PCB.





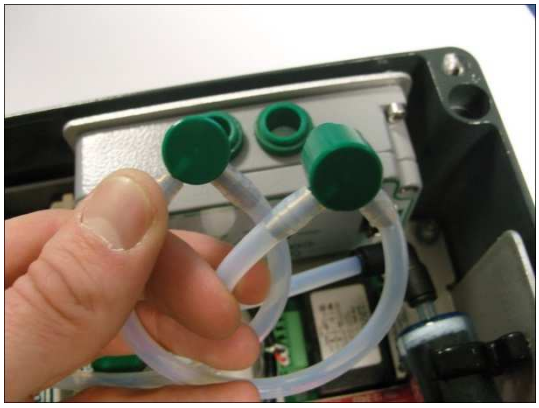
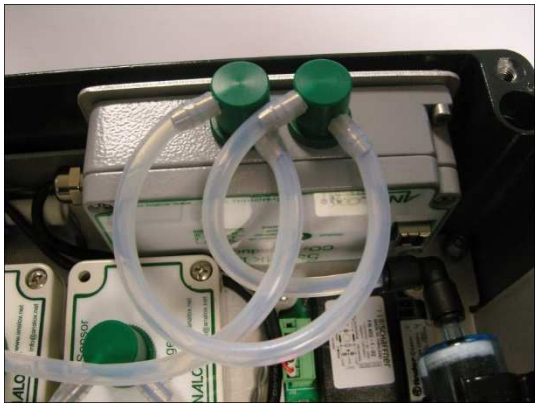
The sensor can now be removed from the enclosure.

9.3.6 Installing a new 5S3 CO_2 sensor

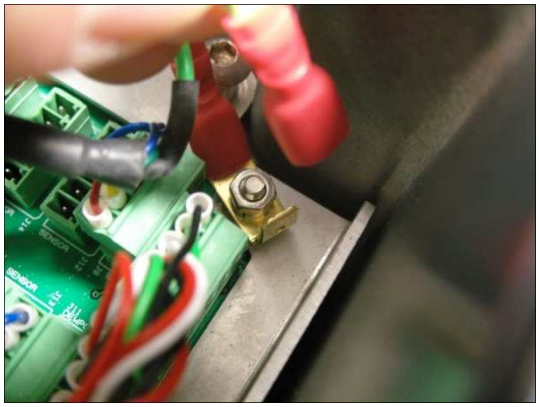
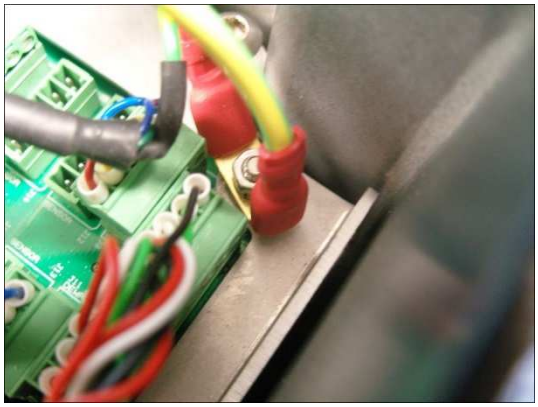
Take the new 5S3 CO_2 sensor module and place the removed M4 hex bolts through the bottom mounting hole, secure to the chassis plate using a 4mm hex key.

Secure the 5S3 in place with the remaining M4 hex bolt using a 4mm hex key.

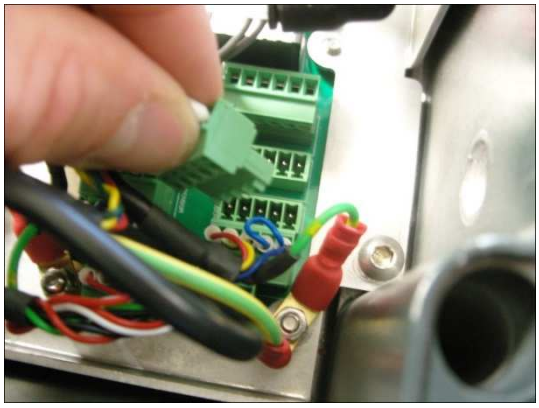
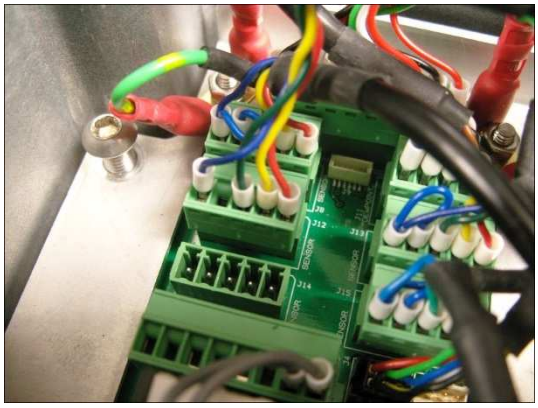
Reconnect the flow adaptors as shown.

Reconnect the earth tag of the 5S3 sensor to the earth stud on the chassis plate.

Reconnect the 5 way plug from the 5S3 lead to J8 on the chassis PCB as shown, this will only fit one way.

10 Specifications

10.1 Instrument specification

Power	Input voltage: 24V DC, Power consumption: 24 W 100 to 250v AC, 50/60Hz (Optional power supply)
Operating current	1 Amp maximum at 24V DC
Display panel	320 x 240 TFT colour graphic display with 10 brightness levels.
Alarm indicators	Onscreen visual indication of faults and internal audible sounder
Operator controls	Push-button membrane
Outputs	Relay (NO and NC contacts) 24V DC max 3x 24V DC switch supply (500mA max total)
Environmental conditions	Rating: IP55 Operating temperature: -5 to +50°C (+22 to 122°F) Storage temperature: -10 to +60°C (+14 to 140°F) Inlet pressure: 5 to 10 bar gauge (72.5 to 145 psig) Humidity: 15 to 90% RH continuous (0 to 99% RH (non-condensing) for short periods (days)) Calibration flow rate: 0.5 to 1.0 LPM
Dimensions	355 x 230 x 134mm (Out of carry case) 406 x 335 x 175mm (In carry case)
Weights	10kg (maximum – including carry case and battery pack)
Sensor response (T_{90}) for system after purge	2 minutes (Sensor path) (6 minutes for H_2O sensor)

10.2 Sensor specification

10.2.1 Oxygen (O_2)

Range	0 to 50%
Accuracy (over ±10°C range)	±(0.035% O_2 + 1% of reading + Temp coefficient) Temp coefficient = 0.15% of reading/°C or 0.084% of reading/°F
Detection mode	Electrochemical
Expected life	2 years for the electrochemical cell in atmospheric air

10.2.2 Carbon dioxide (CO_2)

Range	0 to 1000ppm
Accuracy (over ±10°C range)	±(25ppm CO_2 + 1% of reading + Temp coefficient) Temp coefficient = 1ppm CO_2/°C or 0.56ppm CO_2/°F
Detection mode	Infra-red
Expected life	6 years in operation

10.2.3 Volatile organic compounds (VOC)

Range	0 to 100ppm (isobutylene equivalent)
Accuracy (over ±10°C range)	±(1ppm VOC + 5% of reading + Temp coefficient) Temp coefficient = 0.25% of reading/°C or 0.139% of reading/°F
Detection mode	Photoionisation detection (PID)
Expected life	Lamp - 5,000 hours (~6 months) Cell – 50,000 hours (~5 years)

10.2.4 Carbon monoxide (CO)

Range	0 to 20ppm
Accuracy (over ±10°C range)	±(1ppm CO + 5% of reading + Temp coefficient) 0.1ppm CO/°C + 0.5% of reading/°C or 0.056ppm CO/°F + 0.278 of reading/°F
Detection mode	Electrochemical
Expected life	2 Years in operation

10.2.5 Water vapour (H_2O)

Range	0 to 100mg/m^3
Accuracy (over ±10°C range)	±(0.15mg/m^3 H_2O + 20% of reading)
Detection mode	Capacitive
Service interval	2 Years (service exchange for calibration)

11 Declaration of conformity

DECLARATION OF CONFORMITY

Number: P0149-910-00

Manufacturers name: Analox Sensor Technology Ltd

Manufacturers address: 15 Ellerbeck Court
Stokesley Business Park,
Stokesley,
North Yorkshire
TS9 5PT

It is declared that the following product:

Product name: Analox ACG+
Product code: ACG+

Conforms to all applicable requirements of: The consolidated Environmental Compatibility requirements of IACS E10: 2006, EN 60945: 2002 and the major class society requirements.

The consolidated Electromagnetic Compatibility (EMC) requirements of IACS E10: 2006, EN 60945: 2002 and the major class society requirements.

The above product complies with the requirements of the Electromagnetic Compatibility (EMC) Directive 2004/108/EC

Signed on behalf of: Analox Sensor Technology Ltd
Date: 25 April 2014

Signed:

Name: Mark Lewis
Position: Managing Director

SA127 Issue 3 February 2011

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